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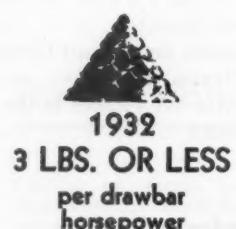
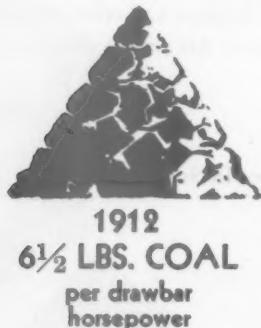
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Why Any 10-Year Old Locomotive Is INADEQUATE

What Has Happened To HORSEPOWER!



What Has Happened To FUEL CONSUMPTION!



SO rapid has been the advance of locomotive design that not a single locomotive in this country over ten years old can begin to hold its own with the really up-to-date power plant on wheels known as the Super-Power locomotive.

**LIMA LOCOMOTIVE WORKS
INCORPORATED**



Railway Mechanical Engineer

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June - 1933

Two Aluminum Passenger Cars On Exhibit at Chicago

TWO passenger cars, unusual in design and constructed almost entirely of aluminum, are among the exhibits which will be of exceptional interest to railroad men at the Century of Progress. One of these cars, a feature of the Pullman Company's exhibit, is the new aluminum observation-room car which has been named the "George M. Pullman." An aluminum observation-coach is being exhibited by the Pullman Car & Manufacturing Corporation.

The Pullman observation-room car, although slightly more than half the weight of a steel Pullman of similar special plan, with air-conditioning and other special equipment—96,980 lb. compared to 180,000 lb.—is equal

Observation-sleeper* designed jointly by the Pullman Company and the Pullman Car & Manufacturing Corporation and a coach designed by the latter save nearly 50 per cent in weight of equivalent steel construction without sacrifice of strength



Commonwealth four-wheel truck with cast aluminum frame used on the sleeper

in strength and safety and represents the Pullman Company's contribution toward the development of lighter railroad main-line equipment suitable for long trains and heavy service. The construction of these cars is an effort to discover whether or not a comparatively light car in which all of the possible luxuries are offered and strength is not sacrificed may indicate a way to reduce operating costs and greater train-earning capacity despite the high initial cost of cars of this type.

Peter Parke, chief engineer, the Pullman Company, in his paper presented before the New York Railroad

Club, said: "While we in our effort to reduce car weight have produced a car in aluminum, we hold no brief for the use of any specific metal. Our selection of aluminum was prompted by the desirable inherent qualities of aluminum alloys; that is, a combination of light weight and great strength. The present high cost of aluminum is likely to come down if the use of these alloys is much extended."

Pullman Observation-Room Car

The exterior appearance of this car differs from the usual Pullman in several respects. The observation end is rounded to permit carrying the observation windows around the end of the car as well as to obtain a modified streamlined effect. The roof is of attractive turtle-back shape, designed and proportioned to reduce to a minimum the appearance of heaviness of the high roof, since the standard car height is maintained for the sake of uniformity of all cars in a train. The necessary louvres and outlets on the roof are, for appearance sake, made of streamlined design. The windows are of special design with round corners, both for the purpose of design and for ease in cleaning. The vestibule side steps are made straight to suit the exterior treatment. The car exterior presents a strikingly attractive appearance, finished in its natural bright metal with surfaces scratch brushed and waxed, having strips of brass-plated aluminum applied to the structure along the eaves, belt rail and sill line to intensify the horizontal line effect. The lettering also is of aluminum, brass plated. Hand-

* The major part of the information pertaining to the Pullman observation-sleeping car in this article was taken from a paper presented by Peter Parke, chief engineer, Pullman Company, at a meeting of the New York Railroad Club held on May 19, 1933.

holds, etc., are of cast brass of the same color as the brass-plated strips. The general dimensions and weights of this car are given in Table I.

Interior Treatment

The interior treatment throughout the car is "contemporary" and no attempt has been made to work along the lines of what is loosely called "modern." In keeping with the present trend the colors used throughout are lighter and brighter than usual.

The observation room is impressive by its dignified gracefulness; beautiful rather than ornate. The bright natural metal finish against the painted background presents a very pleasing effect. The horizontal lines of the interior design are stressed by the use of aluminum moldings.

Illumination in the room is indirect, reflected from the ceiling from bulbs spaced 7 in. centers, located in front of a continuous parabolic rustless-steel reflector applied around the room in segments and located in a cove molding trough. There are no other lighting fixtures in this room.

The three bedrooms present the same dignified and handsome appearance as the observation room, with natural metal finish on painted background on the walls and ceiling and with bright metal mirror frames, trimmings, etc. The drawing room interior design is carried out along the same lines as the other rooms; that is, with metal in natural finish against colored background.

standard six-wheel trucks. The truck frames, made of heat-treated, high-tensile strength aluminum alloy, were cast at the Cleveland, Ohio, plant of the Aluminum Co. of America. They are of especial interest from the standpoint of the materials employed. Problems in design involved provision for great deflection of aluminum and for the sake of safety a determination of safe fibre

Table I—General Dimensions and Weights of the Pullman Aluminum Observation-Room Car

Length over body end sills	79 ft. 1 in.
Length over platform castings	83 ft. 5 1/4 in.
Length between truck centers	59 ft. 6 in.
Length over buffer face angle (free)	84 ft. 9 1/4 in.
Length over pulling face of couplers	84 ft. 3 in.
Length between outside crossbearer centers	29 ft. 6 in.
Width over side sills	9 ft. 9 1/2 in.
Width over sashrest	9 ft. 10 1/2 in.
Width overall at eaves	9 ft. 11 5/8 in.
Height, top of rail to bottom of side sills	3 ft. 7 1/2 in.
Height, track to top of side plate	11 ft. 2 1/2 in.
Height, track to top of roof at center	14 ft. 6 1/2 in.
Height, track to top of floor, inside of car	4 ft. 3 in.
Height, rail to center of coupler	34 1/2 in.
Height, bottom of side sill to top of side plate	7 ft. 6 1/2 in.
Height, top of floor to top of window sill	2 ft. 4 1/2 in.
Height, floor to headlining, center of car	9 ft. 6 1/2 in.
Distance, end sill to buffer beam (vestibule end)	2 ft. 9 in.
Wheel base (trucks)	9 ft. 0 in.
Weights. Of car body, including complete equipment	69,980 lb.
Of trucks including 2,700 lb. mechanical drive	27,000 lb.
Total	96,980 lb.

stress limit. Sample frame castings were made and cut up for examination, a sample truck was built and subjected to static and impact overload test before the final castings were made and these were subjected to a search-



Pullman aluminum observation-room car in process of construction

In the compartment the type of finish is very much the same as in the drawing room, except that the walls are of a clear light blue with ceiling slightly lighter.

The car is fully air conditioned for summer and winter use and, in addition, has exhaust connections to each room for smoke removal independent of the air-conditioning system.

Principal Features of the Truck Construction

The trucks, of the Commonwealth four-wheel type, with 9-ft. wheel base, are designed for double equalization in order to preserve the good riding qualities of

ing X-ray examination for foundry defects before shipment.

The truck is designed for unit fibre stress of 3,500 lb. per sq. in. under static load which is only one-half the stress usually employed in steel trucks, notwithstanding the fact that the yield strength of the heat-treated cast aluminum alloy is equal to that of cast steel. In fatigue test in a rotating beam machine, the cast aluminum alloy employed shows an endurance limit of 7,500 lb. per sq. in., a stress twice as great as the static stress for which the truck is designed and in excess of the combined maximum stresses in service. The tensile

strength average from 27 test specimens is 39,500 lb. per sq. in., the average yield strength 24,400 lb. and elongation average 9.5 per cent in 2 in.

Of major importance is the uniformity of yield strength obtained in these castings; there is only 2,700 lb. variation between the maximum and minimum results of 27 test specimens machined from an integral cast truck frame. This indicates a homogeneous prod-



Underframe construction and method of squaring up the superstructure frame of the sleeping car

uct, an essential factor to successful operation. Experience with these trucks presents the possibility that a properly produced aluminum alloy casting, with its capacity to absorb shocks, due to its lower modulus, and with proper stress limitation, may be even superior to cast steel.

The truck bolsters, spring planks and center forms of the Pullman standard type for six-wheel trucks, modified to suit this particular truck, are all of the same grade of cast aluminum as the truck frame. The clasp

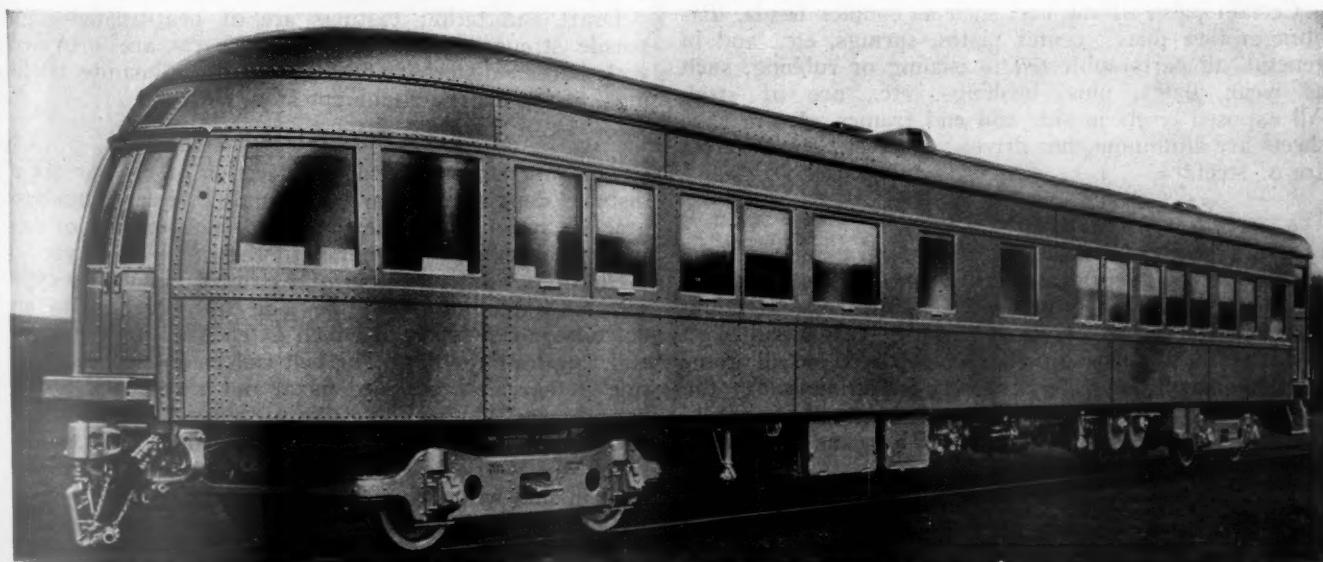
brake arrangement is also of the Pullman standard type with forged aluminum beams and connections.

The center plates are of cast steel. Their arrangement is reversed from the usual practice. The body center plates enshroud the truck center plates. This is an attempt to prevent an accumulation of grit and cinders on the bearing surface of the center plate. Between the truck and body center plate are interposed special composition oil containing bronze bearing plates to reduce friction in rounding curves and to make lubrication of center plates unnecessary. The pedestals are cast separate by reason of the limitation in size of the present available foundry heat treating equipment, otherwise the preferred construction would be to have the pedestal cast as an integral part of the truck frame. All parts in the truck subject to wear are provided with steel wearing plates. Wearing plates are provided on the journal boxes at the pedestal guides, the equalizer feet, and on the inside of the box at the wedge and journal bearing. All brake pin holes in the aluminum brake forgings are bushed and the brake pins are of steel. The ends of the forged aluminum equalizers are protected against wear by spring-steel shoes, shrunk over the foot of the equalizers, and these shoes are further held by $\frac{3}{4}$ -in. countersunk rivets. All spring seats and caps are provided with steel bearing plates. Wheels, axles, springs, journal bearings, and journal-bearing wedges are of the conventional type and not of aluminum. On each truck is a mechanical drive, not made of aluminum and therefore comparatively heavy. The drive on one truck is for the air-conditioning system, and on the other for the 10-k.w. body-hung lighting generator, which also will supply power for the buffet refrigerators, circulating fans, et cetera.

The weight of the two trucks, including the comparatively heavy mechanical drives, one on each truck, is 27,000 lb., including 2,700 lb. as weight of the mechanical drives. The weight of a set of standard six-wheel 11-ft. wheel base steel trucks without special drive is 47,000 lb.

General Features of the Structural Design

The structural design is governed by a strength requirement equal to a steel car which demands: First: That the combined section modulus of the anti-telescoping members at the ends of a car must conform to Pullman standard practice, which is in excess of Railway Mail Service requirements. Second: That the under-

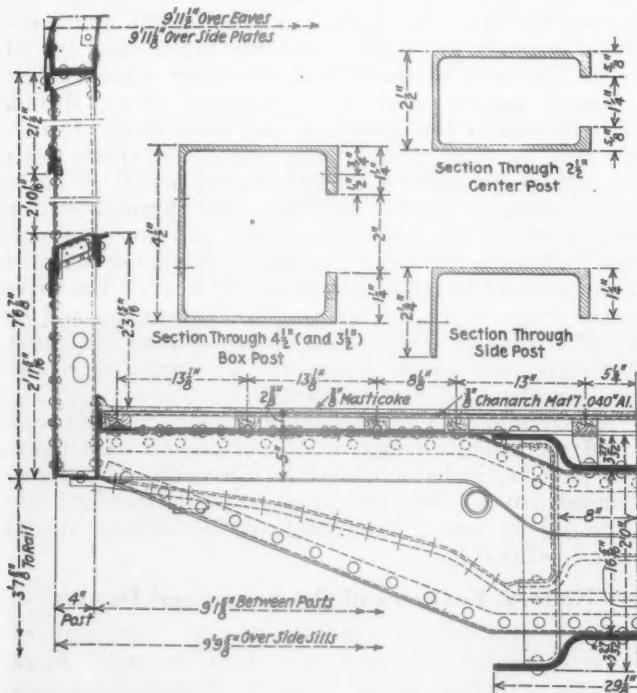


Aluminum observation coach built by the Pullman Car & Manufacturing Corporation

frame members shall withstand, with conservative working stress, a static load of 400,000 lb. applied horizontally at the resultant line of the forces acting at line of buff and draft; 250,000 lb. at line of buff and 150,000 lb. at line of draft. Third: That the total sectional area of the longitudinal members extending from end to end of car and situated below the floor line, shall be not less than 50 sq. in.

Important considerations in designing the aluminum car are:

That the modulus of elasticity of aluminum is only one-third that of steel and therefore the deflection for the same load and section is three times as great; also, that the coefficient of expansion of aluminum is twice that of ordinary steel. Of equal importance is the selection of a suitable alloy and temper from the large variety available. Twelve different grades of wrought aluminum



Sectional details of the sleeping car

alloys and three grades of cast are employed in this car.

Certain parts of the car, such as coupler heads, diaphragm face plates, center plates, springs, etc., and in general, all parts subjected to chafing or rubbing, such as wear plates, pins, bushings, etc., are of steel. All exposed rivets in side and end frames, also in roof sheets are aluminum, hot driven; other structural rivets are of steel.

Underframe

Stress members, whether their office is to take care of draft, buff, straight or combined loading are of the continuous type; center-sill members extending as a unit the entire length of the car. In general, high tensile strength aluminum alloy is employed for all framing members; an alloy closely approximating the strength of steel with an ultimate strength of 58,000 lb. per sq. in., a yield strength of 35,000 lb. and an elongation of 20 per cent in 2 in.

The center sill construction is of fish-belly type, with top and bottom members of heavy plate pressed in U shape, with the outer flanges turned upwardly on the top member and downwardly on the bottom member. At each end solid diaphragm spacers or web plates are pro-

vided between the top and bottom center-still plates, extending from vestibule end sill to a point beyond the truck, taking in the full slope of the bottom member and center sill. Between these spacers the center sill is left open to permit application of the cross bearers and floor pans, which extend in one piece across the car. These members are solidly riveted at their top flanges to bottom of top center sill plate. In addition, pressed spacers extend between the outer flanges of the two center-sill members and are riveted to each floor pan at each side of the center sill. This properly spaces the top and bottom members of the center sill, uniting these members so they co-ordinate to act as a unit column for either buff or draft; and the cross bearers fill the opening between the two members of the center sill at their horizontal flanges and are riveted to them.

The side sill is built up from two extruded metal sections having an interlocking joint between the two extending the full length of the car, which serves to make these two members act as a unit. By this means the floor structure and side framing members are framed in as a unit structure.

The outer member of the side sill is the conventional angle type used in standard Pullman construction. The



Details of the center-sill and cross-bearer construction of the sleeping car

body bolster is of the double type, of construction customary on Pullman cars, and of the same general construction as the body bolster on the steel cars.

Draft and buffer castings are of heat-treated high tensile strength aluminum. Wear parts are provided with hardened-steel chafing plates or Pullmanite bushings, to protect the aluminum from abrasion.

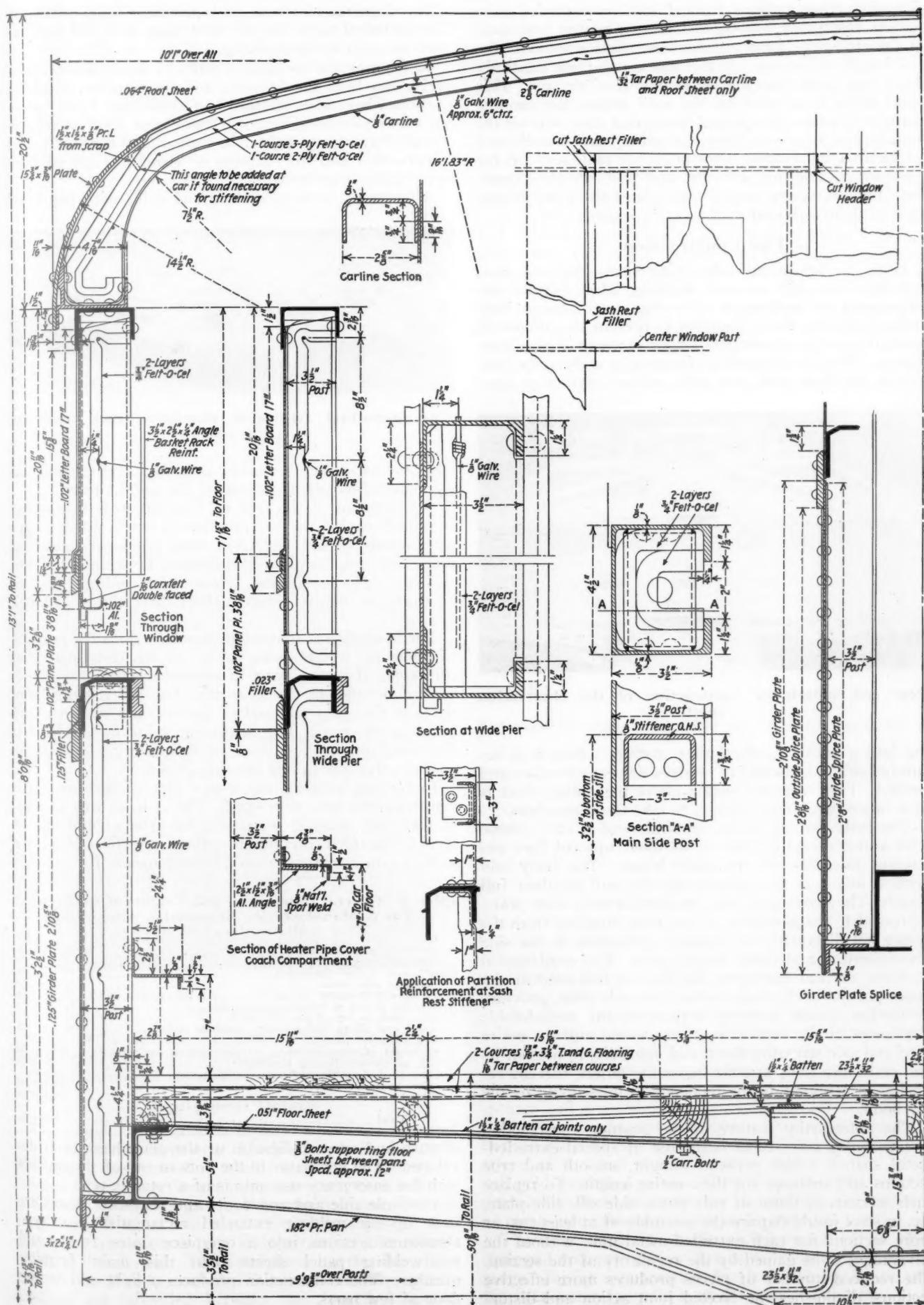
The Superstructure

The superstructure and cross section of the car are a distinct departure from the usual Pullman standard practice, inasmuch as the structural members are of extruded shapes and the roof is of the turtle-back type.

Side posts are made up of extruded metal, box-type sections extending from the side sill members to an extruded-metal top cord which extends in one piece the full length of the car. The belt rail has outside and inside members of extruded metal and a sash rest fitting between and joining these two members. The sash rest also serves as a positive spacer between the posts. Between the vertical walls of the post, spaces are also used in line with the sash rest, thus making the whole section continuous from one end of car to the other.

The bottom of the letterboard is an extruded section which also acts as a drip moulding.

The roof is comprised of pressed channel high-tensile

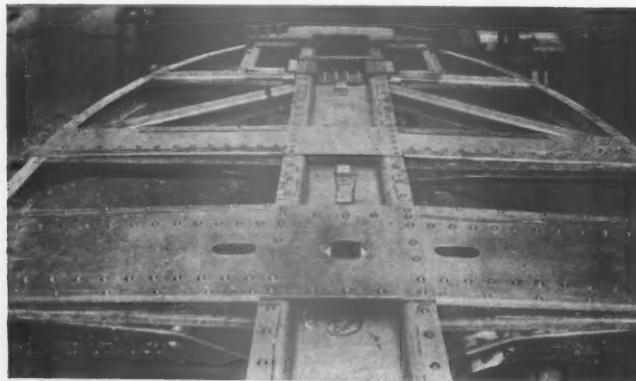


Structural details of the observation coach

aluminum-alloy carlines framed into an extruded eave section resting on top of and riveted to the post caps of the side-plate member, this eave section extends the full length of the car. At the eave a one-piece relatively thick roof plate runs the entire length of the car. This plate starts at a point on the roof where the contour changes towards the general horizontal direction on the outside face of the carlines, extending downwardly and acting as a reinforcing member, cover plate and tie for the main roof section, carlines, eave and side-plate member. Between these special roof plates the conventional type of lighter riveted roof sheets are used.

End Construction

With its heavy anti-telescoping posts the end construction not only exceeds Railway Mail Service requirements as to strength of vertical members at both ends of the car, but is designed to present the utmost of protection to the passengers under extreme impact conditions. This is effected by framing a wedge-type box section vestibule end post with gibbed anchorage cast-



Rear end underframe construction of the observation coach

ing into a pocket in the buffer casting, where it is securely held by bolts and by wedges driven into place and welded. The body end section above the ceiling sheet is of a braced arch type framed to take these members.

The body end sill at the vestibule end is of U shape with anti-telescoping plate at its inner upward face extending inwardly on the underframe. The body end vertical members are framed into this end sill their full length. They consist of two box-section body door posts, a pressed U shape section of box type, running from the center sill diagonally to a gusset connection at the side plate member and body corner posts. The combination of these vertical members, the framed bulkhead at the upper portion of the body end and the side plate, provides protection against extreme impact, as any considerable movement of the vertical members would pull the entire roof and side structure down and inwardly, to present its full resistance to oppose the oncoming object, thereby reducing to a minimum the tendency to telescoping of the car body.

The noteworthy feature of the framing construction as previously referred to is the use of special extruded-metal shapes, which present straight, smooth and true sections and surfaces for their entire length. To replace such sections as those of side posts, side sill, side plate, etc. in steel would require the assembly of at least two or more sections for each extruded-metal unit, without the advantages to be gained by the regularity of the section. The reduced number of pieces produces more effective sections, diminishes the riveted joint action and distortion due to riveting, economizes in weight by elimination

of overlapping members and provides equal strength. The extruded-metal shapes have been designed and applied so as to be interlocking.

In framing the component parts of the structure, simplicity has been the keynote, and the number of pieces employed have been reduced to a minimum. Load carrying cross members in underframe and roof structure, though they may be lighter in section than the usual steel construction are, for stiffness of structure, spaced relatively closer together.

All pressed sections are formed cold, with bends of



The four-wheel fabricated aluminum truck used on the coach

large radius in such a manner that the metal thickness is not reduced nor the character of the metal altered.

Development of the type of framing structure as exemplified on this car has produced a car body structure with relatively less deflection than previously obtained with steel cars, the physical difference between aluminum and steel notwithstanding, which would indicate that an aluminum structure should deflect three times as much as steel.

The insulation is somewhat unusual. With the purpose of reducing weight, also for a service test, insulation consisting of many layers of crumpled aluminum foil is applied throughout the structure. The foil is hung from wires at the sides and end of the car and supported by wires in the roof. The insulating value of this foil is dependent on its high state of reflectivity. It also has special valve due to low heat absorption.

In keeping with the car, a new type of sash and sash ventilator has been developed. The sash, as well as supporting and guiding members, have been built up of special extruded aluminum sections. Such sections are welded into a one-piece sash. Novel means for removal

Table II—General Dimensions and Weights of the Pullman Car & Manufacturing Corporation Aluminum Observation Coach

Length over body end sills	73 ft. 5 $\frac{1}{2}$ in.
Length between truck centers	56 ft. 0 in.
Length over buffer uncoupled	78 ft. 10 $\frac{1}{2}$ in.
Width over side posts	9 ft. 9 $\frac{3}{8}$ in.
Width overall at eaves	10 ft. 1 in.
Height, top of rail to bottom of side sills	3 ft. 5 $\frac{1}{2}$ in.
Height, track to top of roof at center	13 ft. 1 in.
Distance, end sill to buffer beam (vestibule end)	2 ft. 9 in.
Seating capacity	50
Total weight of car (excluding air-conditioning equipment)	67,000 lb.
Weight of air-conditioning equipment	6,880 lb.
Weights (including air-conditioning equipment)	
Car body	55,880 lb.
Trucks	18,000 lb.
Total	73,880 lb.

of sash and easy application of the glass have been developed. The ventilator in the bottom rail of the outside sash for emergency use only is of a rotative type.

Vestibule side and end doors and all locker doors are built up by welding extruded rectangular box type aluminum sections into a one-piece outer frame and spot-welding panel sheets onto this main framing member. The construction produces a light and strong door of few parts.

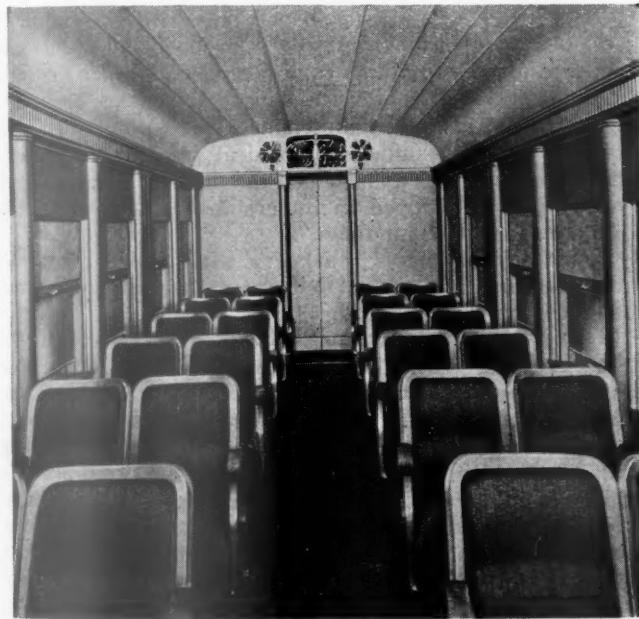
The vestibule trap doors also are built from extruded

aluminum interlocking shapes, welded into a one-piece door. Each door is counterbalanced by two coil springs self-contained in the framed door so as to produce smooth operation, free from any distorting force on the door.

Particular attention has been paid to provide smooth action of draft gears and buffers. Rubber draft gear and buffering devices of high impact capacity with a smooth energy absorbing action throughout the entire range of action are provided. In these gears there is no metallic contact at any time. The extreme movement in draft is $1\frac{1}{4}$ -in. and 2-in. in buff, resulting in a reduction of movement between cars, and due to the nature of the gears, absence of slack or lost motion at all times.

To effect a maximum noise reduction and eliminate rattling diaphragm parts, counterbalanced spring suspension for vestibule foot plate and diaphragm are provided. Side and center buffer stems are ground smooth and true and neatly fitted into Pullmanite bushings, removably bolted into position in the aluminum buffer casting in such a manner that they may be easily removed and replaced when worn. The effect of this construction is to reduce to a minimum the up-and-down movement of the stems and diaphragm face plate, the cause of the slamming noise which occurs on platforms when parts are badly worn.

For effective weatherproofing, a special type of hinged foot plate and vestibule diaphragm is provided. These



Interior view showing the seating arrangement in the coach section

contact tightly with the foot plate. Trap doors and vestibule side doors are thoroughly weather-stripped to overcome infiltration of snow, cinders and dirt.

Equipment Details

The coupler construction is of a substantial although rather experimental design. The head is A. R. A. standard type in cast steel with special built-up aluminum extension. Two heavy forged aluminum straps are machine fitted with dovetailed gibs to the coupler shank and held in place with three 1-in. steel rivets. Spring-steel wear plates are provided at top and bottom of the coupler shank at the carriers. The wear plates lap the side of the coupler shank and are welded thereto. Aluminum spacing castings are provided between the forged extension members, secured by $1\frac{1}{4}$ -in. steel rivets. Fulcrum pin

holes at the rear of the coupler shank extension are steel bushed. Strength of the joint between the cast steel head and aluminum shank was tested under a load applied in 25,000-lb. increments up to 300,000 lb.

In reducing weight aluminum has been used wherever a substitution for steel was deemed practical for such items as: Air brake cylinders, reservoir, valves, pipes and fittings; water-supply tanks, valves, pipes and fittings and heating-system traps, valves, pipes and fittings. Pipes and fittings are of extra-heavy aluminum, threaded with end train-line nipples of steel pipe.

The air-conditioning equipment is the Pullman Car and Manufacturing Corporation system which provides for cooling or heating the car as temperature conditions require, and at all times supplies an adequate amount of filtered, fresh and conditioned air for proper ventilation. The system is fully automatic, thermostats regulate both the cooling and heating system. The ducts are made of aluminum for light weight, and insulated with Alfol. The compressor box, condenser box, blower fan and all supporting members for all parts of the equipment, are made of aluminum.

Principal Features of the Aluminum Observation Coach

The aluminum observation coach has a seating capacity of 50 and weighs 73,880 lb., of which 6,880 lb. constitutes the weight of the air-conditioning equipment. While no car of identical design and capacity has ever been built of steel and an exact comparison of weights is, therefore, impossible, it is estimated that a saving of at least 50 per cent in weight is effected by the present construction. Strong aluminum alloys are used for all parts of the car structure except the wheels, axles, springs, brake shoes and certain other parts subject to wear, which are all of steel or steel-faced for greater durability.

Interior Arrangements and Decorative Treatment

The interior of the car is of the "Modern Empire" mode of decoration or finish. The car is divided into a 25-ft. section, seating 28, in the front end, a 10-ft. buffet, a double card section, seating 8, and a parlor section, seating 14, in the observation end. Two washrooms are provided at the front end of the car and two similar washrooms between the buffet and the parlor for the use of passengers in this section.

The interior architectural treatment is based on columns from the base board to ducts extending along the car sides at about the height of the eaves. These ducts present the form of a header and are the receptacles for lighting fixtures, which are a part of the indirect lighting system.

The floor covering consists of a black marbelized rubber tiling. The double coach seats, with fixed, semi-reclining backs, are built of rectangular drawn aluminum tubing which presents a polished framed edge for the reception of the upholstery. The upholstery is free from springs and is cushioned by rubberized hair with means for holding the material taut and keeping the padded portions in their normal position. The attractive jade green frieze of the seat covering harmonizes with the green and gold damask curtains. More than the usual space is provided between the seats and this permits the insertion of removable tables on which meals may be served.

The enlarged buffet in the center of the car is fully equipped and provided with a novel type of oil-burning range. Buffet refrigeration for both the ice boxes and the soda-water fountain is of the mechanical type.

(Concluded on page 211)

What About Apprentices When Business Picks Up?*

THE last time I visited the back shop, several years ago, it was teeming with activity. A trip through it always proved an inspiration, because of the progressive spirit of the management. You could always be sure of finding several new stunts to improve the quality of workmanship or to increase production.

And then there was the younger group—the apprentices and those more recently graduated. They were ever on the alert to promote worthwhile activities looking either to their own improvement, or for the benefit of the shop or the railroad as a whole. Back of this group, but studiously avoiding the spotlight, was the Apprentice Instructor. Unless you were fairly intimately acquainted with the organization, however, you would never suspect that he was the driving force behind the younger group.

* * *

Today, as I strolled through the plant with the Master Mechanic, the few men employed were already checking out, although it was early in the afternoon—a pathetic reversal from the former conditions.

"What has become of the Apprentice Instructor?" I queried.

"Because of the financial stringency we were forced to abolish the position," replied the M. M., "and we transferred him to an office job—not much of a job, but better than nothing. Some day we hope to put him back in his old position."

"But what about the apprentices?" I said.

"We haven't hired any new boys for a long time," was the reply, "but we still carry those that were with us when we began to slow down."

* * *

A little later I located the Apprentice Instructor. "Just what is happening to the apprentices?" I asked.

"Well," replied A. I., "they do have a few hours' work four days each week. Classroom instruction has been eliminated, but the foremen and lead workers see that the boys receive the necessary coaching on the job. Naturally they have a lot of spare time on their hands and most of them would probably be glad to attend study classes on their own time. Except for my own salary there would be little expense involved, since we have available the facilities and equipment for classroom work. With my demotion and the cuts applying to the lower rate of my present job, I am awfully hard hit. I have wondered, however, if I could get the management to revive the classroom apprentice training, with the boys and myself matching our spare time against the use of the facilities and the little expense required for materials."

"You still believe, then, in a good course of classroom training for railroad shop apprentices," I said.

Three Reasons for Better Training Methods

"Unqualifiedly, yes," he replied, "and for three principal reasons. Look at the boys we have graduated in recent years. Most of them are still with the company and the type of training we have given them is reflected in the reliance we place on them. Several have advanced to minor supervisory positions, although our modern apprenticeship training has hardly been in effect for more than a decade."

* The first of a series of interviews on mechanical department problems with men in that department.

The future of the mechanical department depends upon the statesmanship with which the training problem is tackled

"In the first place," continued A. I., "modern equipment and practices are becoming more and more complicated and we need a higher type of craftsmanship than was required even a few years ago. It looks very much now as if we would have to face even more radical changes in equipment and facilities within the next few years. If the mechanical department is to make good it must have available properly trained mechanics who can successfully tackle these new problems. It requires something more than manual training for the average mechanic to adapt himself to these new conditions. A certain amount of technical instruction is quite necessary."

"Upon just what basis do you make this assertion?"

"Several times in recent years," replied A. I., "when we have introduced new, complicated equipment, recent graduates of the apprentice department have been assigned to its care and maintenance. The older mechanics have not had sufficient technical training to understand the principles upon which the devices operated and were thus handicapped in understanding how properly to maintain and repair them."

"Aside from this," I asked, "what other desirable qualification has characterized the apprentice graduates of recent years?"

"They take a much keener interest in their work," replied A. I. "We have tried to show them just how mechanical department maintenance operations are important from the standpoint of the railroad as a whole, and also to give them a good idea of the more pressing railroad problems. As a result they not only co-operate more effectively in doing their own work, but they have been an important factor in helping to make friends for our road and to educate the public about the importance of and the needs of the carriers. As you know, they have put on several programs here in the community, which have been extremely helpful in cultivating a more friendly feeling on the part of the public."

"What other advantage do you claim for modern apprenticeship methods?"

"There is no question in my mind," replied A. I., "that with the growing complications in facilities and operations it is becoming increasingly important that we give more attention to that type of training which will assist in developing the best possible supervision. While our methods are primarily intended to make good mechanics, nevertheless, we can do much to stimulate the boy who has natural leadership qualifications. We have already seen enough evidences of this among our recent graduates to realize that apprentice training is invaluable in helping to develop men for supervisory positions. The same thing is true in even a more marked degree on the part of the few roads that seriously introduced modern apprenticeship methods almost a quarter of a century ago

(Concluded on page 201)

Delaware & Hudson Develops Triple-Expansion Locomotive



A HIGH-PRESSURE locomotive with water-tube firebox, in which for the first time, so far as is known in the history of the steam locomotive, the triple-expansion principle has been utilized, was recently delivered to the Delaware & Hudson by the American Locomotive Company. This locomotive now constitutes part of the D. & H. exhibit at the Century of Progress Exposition, Chicago. It is the fourth of a series of notable locomotives which have been developed by this railroad at intervals since 1924.

The first three of these locomotives, which are of the 2-8-0 type, were fitted with cross-compound cylinders supplied with steam at working pressures of 350 lb., 400 lb., and 500 lb. per sq. in., respectively. The new triple-expansion locomotive is of the 4-8-0 type and operates with a boiler pressure of 500 lb. per sq. in. All of the same general type of construction which was first of these locomotives are fitted with water-tube boilers

Fourth in a series of locomotives with water-tube fireboxes, the "L. F. Loree" employs 500 lb. pressure through three expansion stages in four cylinders. Total weight, 382,000 lb.; 313,000 lb. on the drivers. A thermal efficiency of 12 to 13 per cent is expected

applied on the "Horatio Allen," built in 1924. A comparison of the principal dimensions and data pertaining to the four locomotives is presented in the table.

The first three of these locomotives have all been subjected to efficiency dynamometer tests over the same section of the line, northbound between Oneonta, N. Y., and Dante, over a .5 per cent compensated grade. The thermal efficiency at the tender drawbar based on coal as fired was as follows:

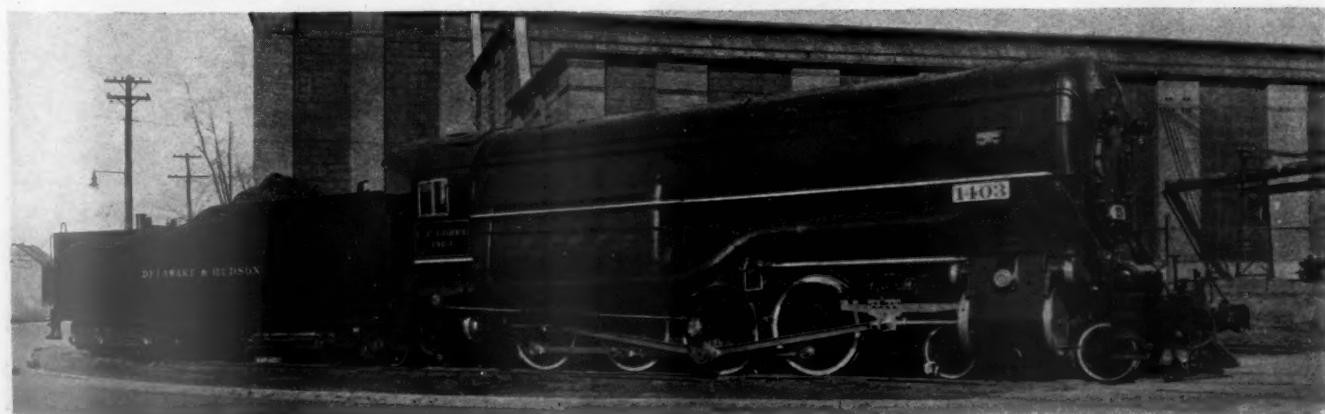
Horatio Allen, No. 1400.....	8.73 per cent
John B. Jervis, No. 1401.....	9.35 per cent
James Archbald, No. 1402.....	10.4 per cent

While no data are yet available for the "L. F. Loree," No. 1403, it is expected that after all adjustments have been made this locomotive, under comparable conditions, will develop an overall thermal efficiency of between 12 and 13 per cent.

The Boiler

The boiler has a water-tube firebox and a fire-tube barrel, the latter of relatively small diameter and completely filled with water. The steam space is in the steam drums of the firebox which are carried forward well beyond the firebox and connected to the barrel near their front ends.

The heating surface in this firebox is not entirely of water tubes. The back head and rear fire-tube sheet connections are water-leg headers, each built of parallel stayed sheets, through which pass the two 21.4 in. water drums at the bottom and two 30.75 in. steam drums at



The Delaware & Hudson triple-expansion locomotive

the top. Ports through the drum shells in the header spaces, provide for circulation between the drums and headers. The front extensions of the steam drums pass through a saddle connection of parallel stayed sheets which is riveted to the boiler shell. Circulation between the barrel and the steam drums, through the saddle, takes place through ports in the shell. The barrel shell is riveted into a flanged opening in the front wall of the front water leg and the rear fire-tube sheet is riveted

riveted drums on the No. 1402 which carry the same boiler pressure, this construction saved 5,274 lb. in the weight of the boiler.

The boiler shell and the two front steam drums, including liners, welt strips, etc., are of silico-manganese steel. Other parts are of suitable grades of carbon steel.

The side walls of the firebox are closed with $\frac{3}{16}$ -in. Ascoloy plate, outside of which are applied successively one $\frac{1}{2}$ -in. layer of No. 319 Johns-Manville cement, a $1\frac{1}{4}$ -in. layer of Superex, a 1-in. layer of 85 per cent sectional magnesia and a $\frac{1}{2}$ -in. layer of No. 302 Johns-Manville cement. Over this the jacket is applied.

Comparison of Delaware & Hudson High-Pressure Locomotives with Water-Tube Fireboxes

Name	L. F. Loree	James Archbald*	John B. Jervis*	Horatio Allen*
Road number..	1403	1402	1401	1400
Year built..	1933	1930	1927	1924
Type	4-8-0	2-8-0	2-8-0	2-8-0
Cylinders, dia. and stroke, in.				
High pressure	20 x 32	20 $\frac{1}{4}$ x 32	22 $\frac{1}{4}$ x 30	23 $\frac{1}{2}$ x 30
Intermediate	27 $\frac{1}{2}$ x 32			
Low-pressure	(2) 33 x 32	35 $\frac{1}{2}$ x 32	38 $\frac{1}{2}$ x 30	41 x 30
Diameter of driving wheels in.	63	63	57	57
Weight lb.				
On drivers	313,000	300,000	295,000	298,500
Engine truck	69,000	56,000	41,500	49,500
Total	382,000	356,000	336,500	348,000
Boiler pressure, lb. per sq. in.	500	500	400	350
Heating surface, sq. ft.				
Firebox and firebrick tubes	1,026	1,114	1,217	1,187
Fire tubes and flues	2,325	2,325	1,904	2,013
Total evaporating	3,351	3,439	3,121	3,200
Superheating	1,076	1,037	700	579
Grate area, sq. ft.	75.8	82.0	82.0	71.4
Tractive force, lb.				
Simple	90,000	84,300	84,300	84,300
Compound	75,000†	70,300	70,300	70,300
Aux. loco.	18,000	18,000	16,200	18,000

*"James Archbald", page 387, July, 1930, *Railway Mechanical Engineer*
**"John B. Jervis", page 207, April, 1927, *Railway Mechanical Engineer*
**"Horatio Allen", page 79, February, 1925, *Railway Mechanical Engineer*

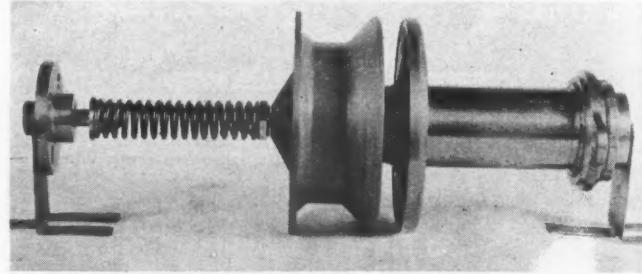
† Triple expansion.

into a similar opening in the back wall of this water leg.

One of the outstanding differences in the construction of the boiler of the "L. F. Loree" as compared with those on the preceding three locomotives is in the use of solid-forged nickel-steel steam and water drums in the firebox construction instead of drums of riveted plate construction. These drums are turned and bored eccentrically, thus providing a thickening of the walls at the sides where the water-tube holes are located. Thus the compensation is effected for the reduction of section through the water-tube holes without the necessity of using plate of this thickness all around. The sections of the steam drums ahead of the firebox are of riveted plate construction. Compared with the butt-seam

Unusual Problems of Design

The utilization of the triple-expansion principle created a number of problems of design, the solution of which required departures from conventional arrangements of parts and the development of some unusual details.



One of the admission valves

The locomotive has four cylinders—one high-pressure, one intermediate-pressure, and two low-pressure. The high-pressure and intermediate-pressure cylinders are embodied in a single steel casting which is mounted in the frames at the rear of the locomotive behind the firebox. The two low-pressure cylinders, which, with the saddle, also form a single casting, are placed in the conventional location under the smokebox. As the illustrations clearly show, the two main rods on each side of the locomotive drive on a single main crank pin. The major problems created by this arrangement are as follows:

1—Provision of clearance and necessary accessibility at the rear cylinders.

2—Driving four sets of steam-distribution valves—two on each side of the locomotive.

3—Provision of variable cut-off relationships between the three expansion stages at different ratios of expansive working required to maintain a satisfactory distribution of the work among the four cylinders.



Frames and cylinders assembled

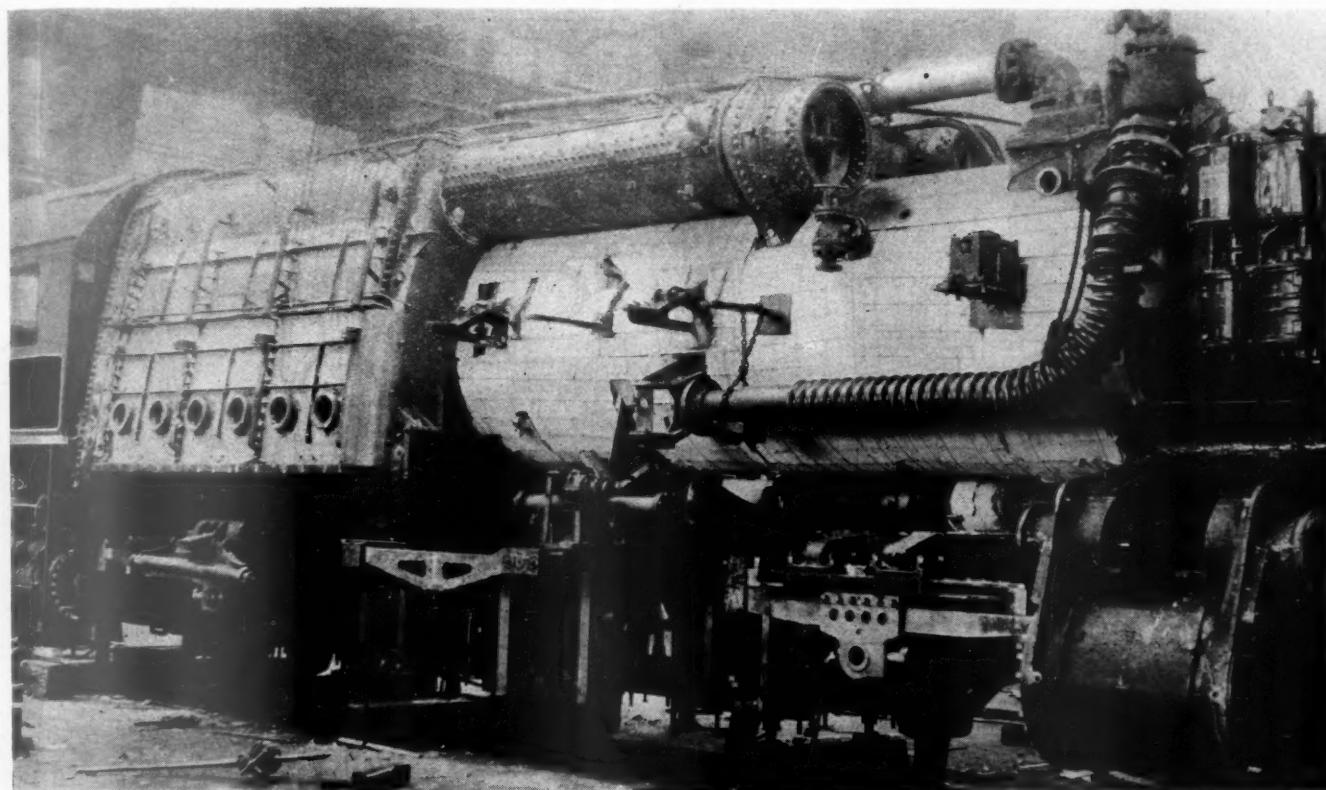
4—The problem of steam-pipe expansion created by the location of the high-pressure cylinder at the rear of the locomotive.

The use of poppet valves provided the basis for the solution of the first problem. The selection of the Dabeg rotary-cam valve motion was the basis for the solution of the second and third problems, and an ingenious design of high-pressure steam pipe and steam-pipe support took care of the unusual expansion problem.

The Steam Pipes

The high-pressure superheated steam is conveyed from the superheater header to a Wagner throttle under the jacket on the right side of the smokebox. From the

care for a variable tendency toward vertical displacement, because of the eccentricity of the expansion and contraction forces. The bracket, which is secured to the boiler, is fitted with bearing pads at the top and two sides. The latter are spaced to provide $\frac{1}{64}$ -in. clearance on each side of the wearing ring, surrounding the pipe where it passes through the support. At the bottom the pipe rests on a spring-supported shoe, fitted to the circle of the pipe. With the pipe pressed against the top pad the compression of the spring is set to exert an upward pressure of about 600 lb. The further compression movement of the spring is limited by stops to $1\frac{1}{32}$ in., at which point the spring exerts an upward pressure against the pipe of something more than 900 lb.



The locomotive in the erecting shop, showing the corrugated section of the high-pressure steam pipe, the support for the valve-motion, worm-gear casing (outside the main pedestal), and the housing for the rigid section of the valve-motion drive shaft (in front of the rear guide)

throttle flange a corrugated steel pipe leads downward and to the rear in a sweeping curve to a seamless cold-drawn steam pipe, 8 in. in outside diameter, which extends back alongside of the right firebox drum to the rear cylinder casting. Here it connects with the high-pressure steam chest. The center line of the rear flange of the corrugated section of the steam pipe is 51 in. below and $115\frac{1}{8}$ in. to the rear of the center line at the top flange. These are cold dimensions and provide for expansion when hot. They are increased when the pipe is bolted in place to $51\frac{1}{16}$ in. and $116\frac{1}{2}$ in. by $\frac{5}{16}$ in. and $1\frac{3}{8}$ in. cold draw, respectively, which is permitted by the flexibility of the corrugated pipe.

When bolted in place the steam pipe is attached at its ends to flanges which bear a fixed relation to each other, while the joint between the two sections of the pipe changes its position with relation to the ends with variations in the temperature of the pipe. The support for the front end of the rear section of the steam pipe must permit longitudinal movement without binding and still

The steam pipe is heavily insulated with a $1\frac{1}{2}$ -in. inner layer of Johns-Manville Superex, a $1\frac{1}{2}$ -in. outer layer of 85 per cent magnesia block lagging, wired in place and covered with Johns-Manville No. 302 cement.

The low-pressure receiver pipe is composed of seamless-steel tubing, of 9-in. nominal inside diameter, which extends from the front face of the rear cylinder casting between the frames. This pipe, which normally carries pressures less than 100 lb. per sq. in., is assembled in four sections, the forward one of which is a slip-type expansion joint. The lagging on the rear section of this pipe where it passes through the ash pan is protected by a jacket of Ascoloy plate. The flanges of both the high-pressure steam pipe and the receiver pipe are bored, shrunk on the steel tubing and welded.

Cylinders and Valves

Except for the low-pressure cylinders, two poppet valves are provided for each end of each cylinder, one of which controls the admission and cut-off and one the

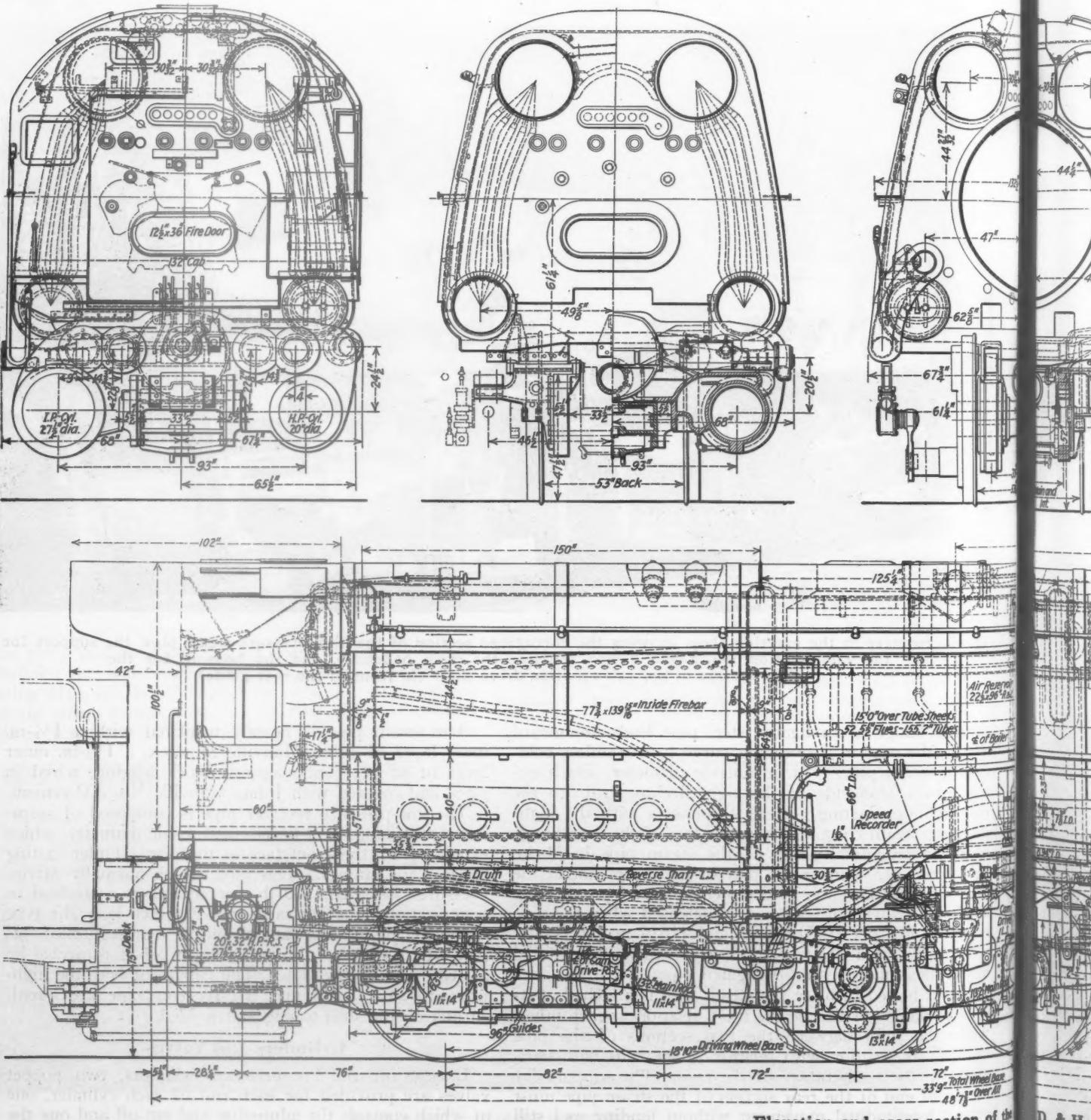
release and compression. These valves are housed in box-like enclosures projecting up from the cylinder barrel over the ports at each end. The poppet valve stems extend through glands in the inner walls of these housings toward the cam box which is placed over the middle of the cylinder barrel. The valve-stem glands are subjected to the exhaust pressure from each of the cylinders.

With the exception of the exhaust valves for the intermediate-pressure cylinder and the admission valves for the low-pressure cylinders, which are $9\frac{1}{2}$ in. in diameter, all valves, both inlet and exhaust, provide openings 9 in. in diameter. In the case of the low-pressure cylinder two 9-in. exhaust valves are provided

at each port, located outside of the admission valves.

The high-pressure exhaust passes directly from the valve, which is located inside (toward the longitudinal center line of the locomotive) to the intermediate-pressure receiver. This is a chamber in the casting between the two cylinder barrels approximately 33 in. in diameter and about 48 in. long. This receiver is connected directly to the intermediate-pressure admission-valve chambers. Passages from the exhaust valves of this cylinder converge in a single passage cored through the receiver space to the opening in the front face of the cylinder casting on the center line of the locomotive, to which the low-pressure receiver pipe is connected.

The intercepting valve is housed within the low-pres-



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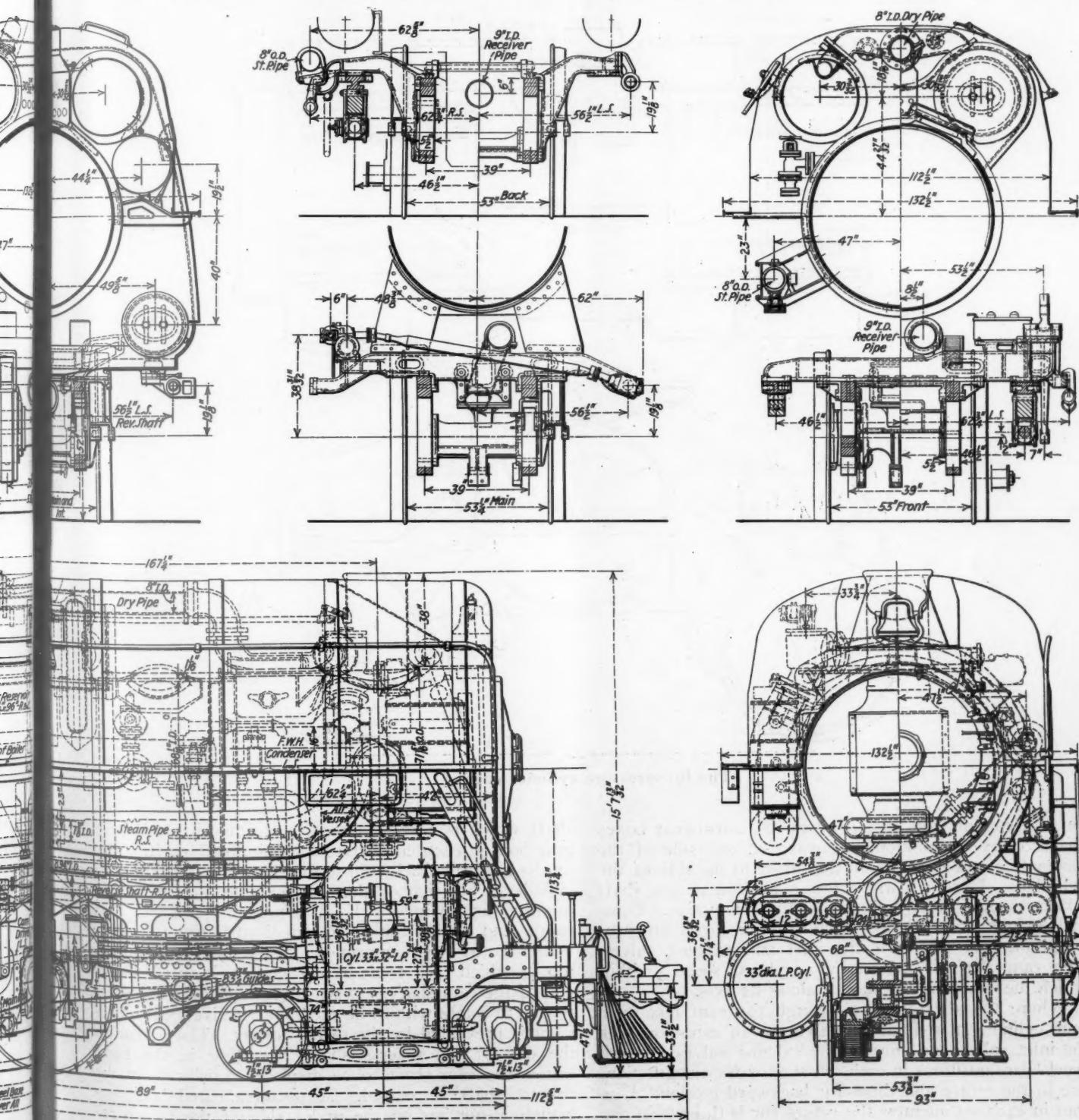
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sure receiver chamber in the front saddle casting. It functions automatically in starting to close the intermediate exhaust from the low-pressure receiver and to admit high-pressure steam, through a reducing valve, into the receiver and, as the intermediate exhaust pressure builds up, to open the receiver pipe to the low-pressure receiver volume and cut off the high-pressure steam supply. It may be operated by manual control at any time to divert the intermediate exhaust to the atmosphere and admit high-pressure steam, through a reducing valve, to the low-pressure receiver.

In starting, steam is fed to the intermediate-cylinder receiver directly from the high-pressure steam chest through a spring-loaded feed valve, which closes when

a pressure of 170 lb. per sq. in. has been built up in the receiver. When the locomotive is being operated simple, so-called, the exhaust from the intermediate cylinder passes through a back-pressure valve which maintains about 83 lb. per sq. in. pressure in the low-pressure receiver pipe. Except for the slightly lower intermediate back pressure, the high-pressure and intermediate-pressure cylinders continue to operate as in triple expansion. The increase in tractive force is largely produced by the increased admission pressure in the low-pressure cylinders.

When working short cut-offs in triple-expansion a valve in the cab permits the engineman to admit a limited amount of steam taken from the boiler in order to



boost the steam pressure in the low-pressure receiver.

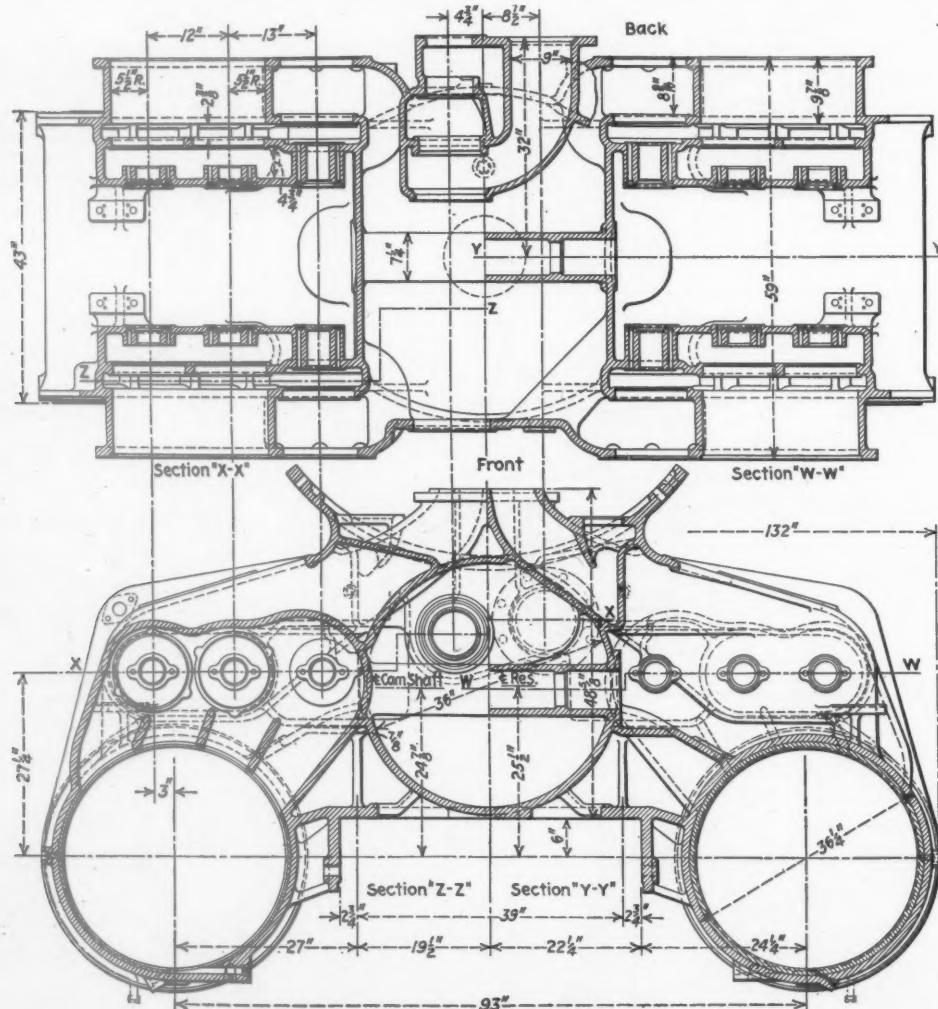
The Valve Motion

The valve motion for each pair of cylinders is furnished by a single drive. The motion for the high-pressure and intermediate-pressure cylinders is taken from the right main crank pin and that for the two low-pressure cylinders from the left main pin. The motion is provided by a crank arm on the end of each crank pin, the other end of which is in line with the center of the axle. From this point a shaft extends out about 10 in. to the worm gear box. As the latter is supported rigidly by a frame yoke, the short shaft is provided with uni-

sides of the shaft. The rockers cause the valves to open by pressure on the stems. The valves, which are of thin section and light weight, are closed by springs.

The longitudinal drive shafts which provide the power for the transverse cam shafts are each divided into three sections. Each end section, which is 70 in. long, is provided with a splined slip joint and a universal joint at one end and a universal joint only at the other end. The middle section is carried in bearings which are supported by a yoke from the main frames.

The cut-offs of all four cylinders are controlled by a single reverse gear. A rack between the two heads of the trunk piston of the reverse-gear rotates a transverse



The low-pressure cylinder casting

versal joints at both ends. From the worm-gear boxes shafts carry the motion, backward on one side of the locomotive and forward on the other, to the side of the cylinders. Here a worm drives a horizontal cam shaft which extends transversely across the locomotive. Cams in housings mounted over each cylinder barrel are provided on this shaft for the inlet and exhaust valves. The cam shaft is driven by a splined sleeve, within which the shaft may be moved along its axis.

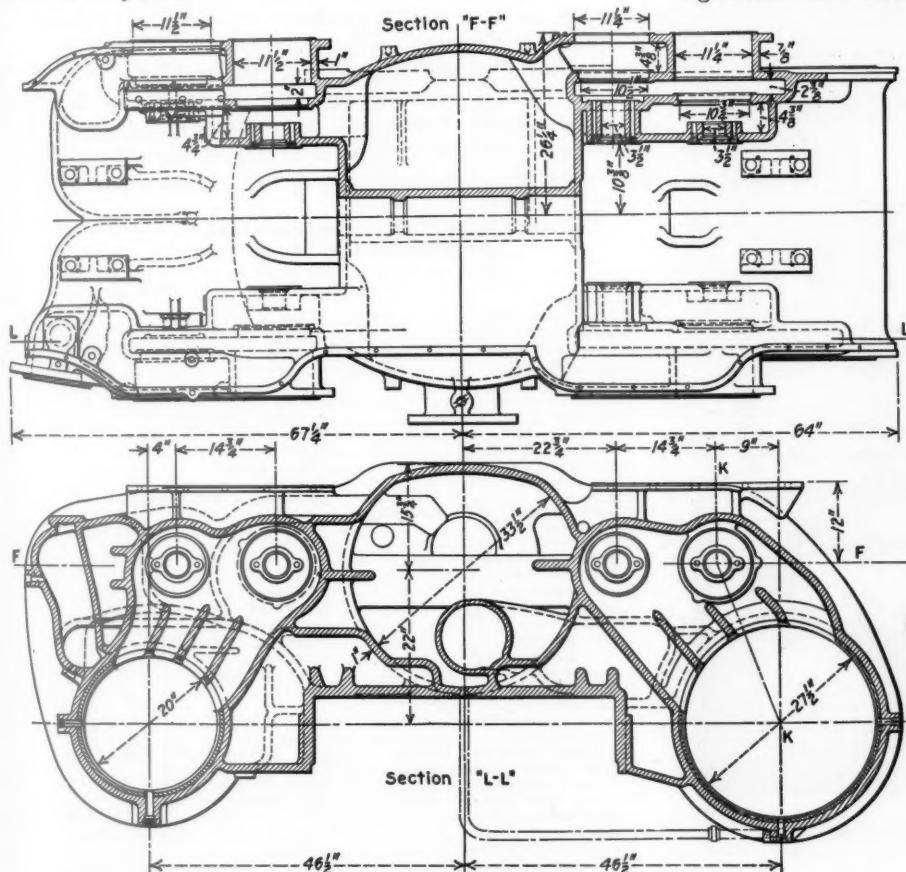
Where the shaft passes through the cam box over each cylinder it is fitted with two sets of cams, one for the inlet valves and one for the exhaust valves. There are 10 cam positions in each set, six for forward motion, one in the center and three for backward motion. One cam in each set operates the valves for both ends of the cylinder through rollers and rockers placed on opposite

shaft which is carried across the locomotive. A bevel gear box on each end drives a longitudinal shaft. That on the left leads backward to the side of the intermediate cylinder, while that on the right extends forward to the low-pressure cylinder. Each terminates in a gear box on the end of the transverse cam-shaft housing opposite to the worm-drive connection. A heavy sleeve, on the top of which rack teeth have been cut, is fitted on the end of the cam shaft between thrust collars. The shaft is free to rotate within the rack, but relative axial movement is prevented by the thrust collars. The pinion on the end of the reverse shaft, operating in the rack, causes the cam shaft to be displaced axially when the reverse shaft is rotated. A piston-actuated latch engaging V-notches on the under side of the power reverse-gear rack serve to divide and lock the gear travel

into steps which correspond to the distance between cam centers.

Attention has already been called to the problem of satisfactorily varying the relationship between cut-offs of the three expansion stages as the rates of expansive working of the steam is changed. Had three separate valve motions been employed, three reverse gears would have been necessary, each requiring separate manual control, or at least a difficult problem of interlocking control would have been presented. The use of the rotary cam motion permitted the use of the single reverse gear which has just been described.

The use of the cams, however, limits the number of working cut-offs to the number of cams which can be brought in line with the rocker arms which move the poppet valve stems, two pairs of which are required for each cylinder.



The high- and intermediate-pressure cylinders

cylinder, but all are shifted together, any predetermined combinations of events for the three expansion stages may be provided for each operating position of the reverse gear, and the four events—admission, cut-off, release and compression—can be fixed independently of each other. The relation of the cut-offs is shown in the table.

The shafts of both the valve gear and reverse gear are fitted with regular stock automotive-type universal joints. The body of the reverse shaft is made of 4-in. steel tubing.

Frames and Running Gear

The main driving wheels are of box section, somewhat lighter in weight and considered less subject to cracking than the conventional design. The main driving boxes are fitted with S.K.F. roller bearings, the

In this design nine cams are provided in each set, making 36 in all on each transverse shaft. These provide six changes of cut-off in forward motion, with suitable changes in admission, release and compression, and three changes in backward motion. The center cams in

journal size being 13 in. by 14 in. The journals of the remaining drivers are crown type, 11 in. by 14 in. The four-wheel engine truck is of the Alco constant-resistance type, with inside plain bearings. The side frames and journal boxes are cast integral. Instead of the usual cellars, provision is made for access to the inside of the boxes for lubrication through handholes in the front and back walls, respectively, of the two boxes in each side frame.

In the connection and drive of the back ends of the two main rods on the main crank pin the principle of the tandem main rod is employed. The main rods, side rods, piston rods and the connecting rods of the auxiliary locomotive are of carbon nickel steel, quenched and tempered, the specification of which call for a minimum yield point of 75,000 lb. per sq. in. The use of this material effected a reduction of $37\frac{1}{2}$ per cent in the weight as compared with carbon steel. The eccentric is of carbon vanadium steel.

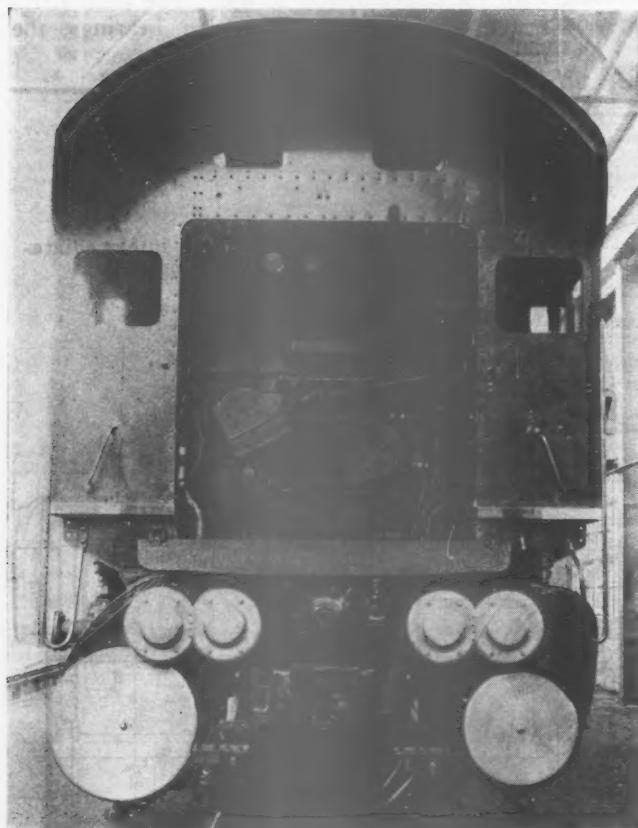
The frames are separate high-manganese steel castings which are secured to the steel cylinder castings,

Cut-Offs in Per Cent of Stroke									
	H. P.		I. P.		L. P.				
Cam positions	F.	B.	F.	B.	F.	B.	F.	B.	F.
1 (Full stroke forward)	87 $\frac{1}{4}$	90	87 $\frac{1}{4}$	90	90	87 $\frac{1}{4}$			
2	66	71	66	71	43	37 $\frac{1}{2}$			
3	58	63	62 $\frac{1}{2}$	68	43	37 $\frac{1}{2}$			
4	50	56	58	63 $\frac{1}{2}$	43	37 $\frac{1}{2}$			
5	43	49	53	59	43	37 $\frac{1}{2}$			
6	36	42	48 $\frac{1}{4}$	54 $\frac{1}{4}$	43	37 $\frac{1}{2}$			
7 (Center)	36	42	48 $\frac{1}{4}$	54 $\frac{1}{4}$	43	37 $\frac{1}{2}$			
8	36	42	48 $\frac{1}{4}$	54 $\frac{1}{4}$	43	37 $\frac{1}{2}$			
9	66	71	66	71	43	37 $\frac{1}{2}$			
10 (Full stroke backward)	87 $\frac{1}{4}$	90	87 $\frac{1}{4}$	90	90	87 $\frac{1}{4}$			

both the inlet and exhaust sets are true circles, of sufficient diameter to hold all valves open, except the high and intermediate-cylinder admission valves, thus providing for free circulation between opposite ends of the cylinders when drifting. As each set of cams controls either the inlet valves or the exhaust valves for a single

front and back, by bolts and keys. Aside from the cylinders, the principal transverse bracing comprises the front bumper, deck and guide-yoke crosstie which is an integral steel casting extending under the cylinders and about 80 in. back of the cylinder casting.

The guides are of the single-bar type. Those for the front cylinders are supported in the usual manner, the front ends on the rear cylinder heads and the rear ends from the guide yoke. The rear guides are entirely separate from the cylinders and are supported from the frames at both ends. Neither of these supports is carried across between the frames. In the case of the rear supports, the low-pressure receiver pipe interferes and, in the case of the front-end supports, the ash pan is an additional obstruction. At the latter location, however,



The rear end of the locomotive

a bolt-and-sleeve spacer is inserted between the lower frame rails.

The rear supports of the rear guides also serve as expansion pads for the rear end of the firebox, brake-hanger brackets for the rear drivers, and as the attachment for the Nathan non-lifting injector. The front-end supports for the rear guides also provide an anchor for the main steam pipe on the right side, carry the intermediate bearing for the rear-cylinder valve-motion drive shaft (also on the right side) and the brake hanger for the No. 3 driving wheels on both sides.

Other Features

The locomotive is equipped with the Dabeg feedwater heater, with which the D. & H. has already had considerable experience. This device is an open-type heater and is operated by a pump which takes its power from the left front crosshead.

The cylinder and valve lubrication is provided by a 32-feed Bosch force-feed lubricator. This feeds oil to all valve stems, to the cam boxes over each cylinder, to

each cylinder barrel and to the front and back driving-box hub liners. The lubricator is located over the left front guide and is driven from the feedwater-heater crosshead connection.

The locomotive is provided with two duplex steam gages. One registers pressure in the high-pressure steam pipe and in the intermediate-pressure receiver. The other shows the pressure in the low-pressure receiver and at the low-pressure exhaust.

The cylinder-saddle and cylinder-frame bolts are of high tensile steel. Similar material is also used for the guide bolts and it is also employed in the studs for the steam pipe and header flange, the boiler check and cab turret.

Results in Service

Following the delivery of the locomotive time for complete tests was not available before the locomotive was sent to Chicago to be placed on exhibition at the Century of Progress Exposition. A series of dynamometer-car runs were made, however, to check the tractive capacity of the locomotive at various cut-offs, in the course of which observations of boiler and steam-chest pressures for the three expansion stages were made.

List of Special Parts, Appliances and Equipment Applied on the "L. F. Loree"

Owner	D. & H.
Builder	American Locomotive Co.
Boiler details:	
Blower connection	Barco
Blow-off valves	Okadec
Boiler steel	Lukens
Brick arch	Economy
Coal sprinkler	Nathan
Feedwater heater	Dabeg
Fire door	Franklin Butterfly
Steam injector	Type "W," Hancock
Wrought-iron pipe	Byers
Staybolts	Ulster special
Throttle valve	Wagner
Unions	Kewanee, extra heavy
Cabs, fittings and boiler mountings:	
Bell ringer	Transportation Devices Corp.
Cab valves	Hancock
Flexible connections between engine and tender	Barco
Gage cocks	Hancock
Low water alarm	Cleveland
Sanders	Graham-White
Speed recorder	Model K, Valve-Pilot
Steam gages	Ashcroft
Turbo generator	Pyle-National
Water columns	Nathan
Engine and running gear:	
Auxiliary locomotive, six wheel.	Bethlehem Steel Co.
Cylinder cocks	Okadec
Drawbar, engine and tender	Unit Safety, Franklin Ry. Supply Co.
Driving boxes (except main)	Cast steel, Lebanon
Driving boxes, main	Roller bearing, S.K.F.
Driving wheel centers, main	Alco box section
Engine truck	Alco constant-resistance, inside bearing
Frames	General Steel Castings Corp.
Mechanical lubricator	32-feed, Bosch
Pilot beam and underframe braces	General Steel Castings Corp.
Rod and valve-stem packing	King type, U. S. Metallic Pack. Co.
Springs	Railway Steel Spring
Valve gear	Dabeg
Tender and miscellaneous:	
Air brake	New York
Coupler, pilot	American Steel Foundries
Draft gear	Miner A78XB, with Farlow 2-key attachment

Steam and feedwater temperatures were also recorded. The highest drawbar pull recorded, without the assistance of the auxiliary locomotive, was 82,000 lb., the locomotive operating triple expansion at 87½ per cent cut-off, and at a speed of 4 m.p.h. Operating at a constant speed of 4 m.p.h. and 66 per cent cut-off, ascending a .24 per cent grade, drawbar pulls of 61,000 to 63,000 lb. were recorded. The trains on which these observations were made consisted of 4,763 actual tons in 71 cars, the dynamometer car and the caboose. With a train of 6,103 actual tons in 92 cars, the dynamometer car and the caboose, the locomotive operating at 66 per cent cut-off with the auxiliary locomotive cut in, developed a maximum drawbar pull of 74,000 lb. at the top of a .52 per cent grade, operating at about 4½ m.p.h.

On another run, with a train of 3,274 actual tons in 50 cars, the dynamometer car and a caboose, the locomotive developed a drawbar pull of 37,000 lb. working in 50 per cent cut-off at a practically constant speed of 20 m.p.h. on a .42 per cent grade.

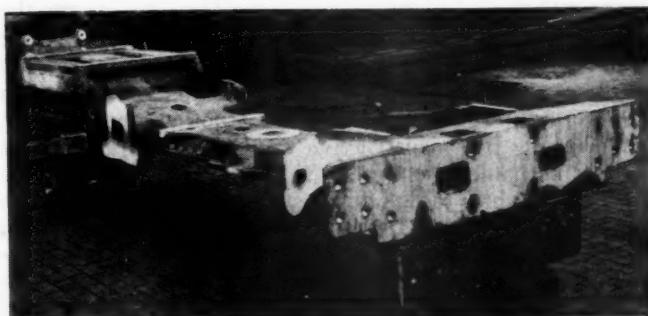
Operating in 66 per cent cut-off at speeds of from

Table of Dimensions, Weights and Proportions of the "L. F. Loree"

	D. & H.
Railroad	4.8-0
Type of locomotive	Freight
Service	
Cylinders, diameter and stroke:	
High-pressure	20 in. by 32 in.
Intermediate-pressure	27½ in. by 32 in.
Low-pressure (2)	33 in. by 32 in.
	H.P. I.P. L.P.
Cylinder clearance, per cent	13.5 9.4 8.8
Valve gear, type	Dabeg, Rotary cam
Valves, double-beat poppet, size:	
High-pressure, both	9 in.
Intermediate-pressure	Admission 9 in. Exhaust 9½ in.
Low pressure	1. Admission 9½ in. 2. Exhaust 9 in.
Maximum lift:	
High-pressure and intermediate admission	1 in.
Low-pressure admission	1-1/16 in.
High-pressure and low-pressure exhaust	1 in.
Intermediate exhaust	1-1/16 in.
	H.P. I.P. L.P.
Release in shortest cut-off:	8½ in. 5½ in. 4½ in.
Compression in shortest cut-off:	3 in. 3 in. 3½ in.
Weights in working order:	
On drivers	313,000 lb.
On front truck	69,000
Total engine	38,200
Tender (full load)	274,500
Wheel bases:	
Driving	18 ft. 10 in.
Rigid	18 ft. 10 in.
Total engine	33 ft. 9 in.
Total engine and tender	83 ft. 8¾ in.
Wheels, diameter outside tires:	
Driving	63 in.
Engine truck	33 in.
Journals, diameter and length:	
Driving, main	13 in. by 14 in.
Driving, other	11 in. by 14 in.
Engine truck	7½ in. by 13 in.
Boiler:	
Type	Water tube—fire tube
Steam pressure	500 lb.
Fuel, kind	Bit. coal
Diameter, first ring, inside	68-1/16 in.
Firebox, length and width	139-15/16 in. by 77¾ in.
Arch tubes, number and diameter	6-3½ in.
Tubes, number and diameter	155-2 in.
Flues, number and diameter	52-5½ in.
Thickness, tubes	No. 12 min. B. W. G.
Thickness, flues	No. 5, min. B. W. G.
Length over tube sheets	15 ft.
Grate area	75.8 sq. ft.
Heating surfaces:	
Firebox	965 sq. ft.
Firebrick tubes	61 sq. ft.
Boiler tubes	1,209 sq. ft.
Flues	1,116 sq. ft.
Total evaporative	3,351 sq. ft.
Superheating	1,076 sq. ft.
Combined evaporating and superheating	4,427 sq. ft.
Tender	
Water capacity	14,000 gal.
Fuel capacity	17½ tons
Rated tractive force:	
Simple	90,000 lb.
Triple-expansion	75,000 lb.
Auxiliary locomotive	18,000 lb.
Weight proportions:	
Weight on drivers+total engine weight, per cent	81.9
Weight on drivers+tractive force (simple)	3.48
Weight on drivers+tractive force (triple expansion)	4.17
Total weight engine+comb. heat. surface	86.2
Boiler proportions:	
Tractive force (triple exp.)+comb. heat. surface	16.9
Tractive force (triple exp.)×dia. drivers+comb. heat. surface	1,064.7
Firebox heat. surface (incl. firebrick tubes)+grate area	135.3
Firebox heat. surface (incl. firebrick tubes), per cent evap. heat. surface	30.6
Superheat. surface, per cent evap. heat. surface	32.2

4 to 16 m.p.h., a pressure drop of about 13 to 20 lb. is indicated between the boiler and the high-pressure steam chest. Boiler pressures varied from 485 to 500 lb. With full pressure in the boiler at speeds of 4 to 6 m.p.h., the intermediate receiver pressure varied from 270 to 285 lb. and the low-pressure receiver pressure from 88½ to 97½ lb. per sq. in. At higher speeds somewhat lower intermediate cylinder pressures are in-

dicated. As the cut-off is reduced, the pressure in the intermediate receiver is also reduced to about 235 lb. per sq. in. at 58 per cent and 215 lb. per sq. in. at 50 per cent. The highest steam temperatures recorded were 710 deg. F., operating at 58 per cent cut-off, and consistent



The front bumper, deck, engine-truck center plate, guide-yoke support, brake-cylinder pad and brake-lever fulcrums are embodied in one steel casting

readings of about 665 deg. were obtained in a number of observations with the locomotive operating at 66 per cent cut-off. With final completion of adjustments in the drafting of the locomotive, however, it is anticipated that temperatures of 700 deg. and upward will be obtained regularly.

What About Apprentices When Business Picks Up?

(Continued from page 192)

and have consistently followed them up, at least until the depression seriously upset mechanical department organizations."

"What is giving you the greatest concern at the present time?" I asked.

"Just this," replied A. I. "Apprenticeship instruction has been discontinued in the mechanical departments of most railroads. Nobody seems to be greatly concerned about it. I am afraid that when business starts to pick up, the officers of the mechanical departments will be so hard pushed that they will lose sight of apprenticeship and we will lose the effect of a movement which it took a quarter of a century to get well started. That is one of the reasons why I personally would be willing to make a considerable sacrifice of time and energy, if I could find some way of starting ahead on at least the temporary basis which I have suggested above. Surely the railroads cannot afford to drop a worthwhile effort which has so much promise for the future—an effort which has fully justified itself in the past, as you have so frequently noted in the columns of the *Railway Mechanical Engineer*.

ILLUSTRATION OF RAILWAY TRAVEL SAFETY, GERMAN STYLE.—The German railways have devised a novel means of advertising the safety of travel by railway. In a large placard displayed in Berlin, there is shown a man with white hair and a beard so long that it virtually covers the floor of a passenger car compartment. The inscription reads, "He wanted to be killed in a railroad accident. He will have to travel 100 kilometers (62.13 miles) an hour for 22,800 years in order to accomplish his purpose."

Reactions to Traffic Officer's Suggestions

WE have received a number of comments on the suggestions which were made by the Freight Traffic Officer on page 159 of the May number of the *Railway Mechanical Engineer*. This was the first of a series of interviews with officers of other departments, commenting in a constructive way upon the possibilities of the mechanical department.

The Freight Traffic Officer suggested the use of specially designed light, high-speed locomotives and small, four-wheel freight cars, for the expeditious and economical handling of l. c. l. and light freight shipments. A surprisingly large number of the letters commented favorably upon these suggestions. Not all of them, however, are in accord with R. T. O., as may be seen from a study of the following excerpts taken from letters received from operating, traffic and mechanical department officers. These particular excerpts were selected either because of their constructive suggestions, or for their pointed views of R. T. O.'s suggestions; incidentally they come from widely scattered sections of the country.

From a Mechanical Department Officer—There is no question but that we are going to lighter weight equipment for certain services. The principal question is as to what route we will follow. There are two principal sources of freight revenue. The heavy-tonnage low-cost and the lighter-tonnage high-cost traffic. The bulk of the income has always come from the first while the keenest competition has been encountered in the second. Now, can the two be harmonized? Or should there be a divorce and remarriage? Passenger traffic has been declining, perhaps disappearing is a better word. Why not take what is left of local passenger, combine it with competitive freight and produce a union which might be called "a glorified mixed" train service? Then we could construct a real light-weight car which would be possible by reason of passenger handling. This would also ease the packing requirements which, in many cases, have "broken the camel's back."

From an Operating Officer—Any one who has ever worked on a railroad where four-wheel cars were in use, such as four-wheel cabooses, knows what a nuisance they are and, frankly, I would not dare to run such a car in one of our long freight trains today. Any discussion of such small cars is a step in the wrong direction.

Of course, improvement can be made in cars. What is wanted particularly is a better riding car. Car department officers formerly thought that better draft gears would be a cure-all. Now we know that freight is damaged by vertical jiggling which can be prevented by proper trucks. It is the railroad's own fault that so little freight is put in cars. There is no incentive given to a shipper to load cars heavy. A few experimental rates have been put in giving a lower rate per 100 lb. for heavier loaded cars. By far and large, it is a car-mile rate that should be looked at rather than a ton-mile rate. Giving the shipper the advantage in loading cars heavily will bring about better loading.

Special cars are a nuisance. Refrigerator cars are moved empty in one direction. The same applies to tank cars, hopper cars and most special cars. Trucks on the highways get a load both ways and the trend should be toward cars that can be utilized in both directions in so far as possible. At least it is something to shoot at.

From a Traffic Officer—The mechanical officers have done a magnificent job in reducing the cost of transpor-

No general agreement, but his comments in the May number have clearly focused attention upon a real need

tation by means of heavier train loading. The price which the traffic department must pay as a result of the excessively large and heavy equipment is relatively slow speed, infrequent service and high tare ratio. A great field, I believe, lies open to an attack upon the problem from the other angle, that is, an attempt to design light speedy trains, which are as economical to operate per net ton-mile as our present drag freights.

I agree with the suggestion that we should have freight cars designed to handle l. c. l. traffic and small car lots. The present large cars, in so far as handling of l. c. l. freight is concerned, means that we must handle from four to seven times as many pounds of tare weight as we do of net weight. Whether or not this should be corrected by substitution of small cars of the European type, as suggested, or by the use of some form of a demountable container interchange with truck chassis is debatable. The possibility of reducing our terminal costs through motorization is yet to be explored. If those of us who feel that motorization of terminals would accomplish substantial operating economies are right, then the body of the freight car, whether it be upon the small chassis suggested in the article, or several small units upon the large chassis of our present cars, must be interchangeable with the truck chassis.

The design of special equipment for l. c. l. merchandise and for small carloads is an illustration of a general need for equipment designed primarily for the traffic which is to be handled. Automobile traffic is an illustration. The present ratio of tare to net weight in the direction of the loaded movement only is a little less than four pounds of tare to one pound of net weight. If possible, cars should be designed which would reduce this ratio to approximately one-to-one. Similarly, if cars for the movement of petroleum were designed which would double the present net load without substantially increasing the tare weight, traffic departments would be in a much better position to meet the competitive rates of pipe lines.

I am in complete agreement with the author of the article that our cars should be shock-proofed. A very large part of the cost of transportation of non-bulk freight consists in packaging, which is nothing more or less than temporarily shock-proofing our container. Shock-proof devices, better springs, brakes and wheels are highly essential if we are to meet competition of highway vehicles upon a service basis.

From a Mechanical Department Officer—If the railroad traffic officer quoted is an actual character, I think that he is too far away from the mechanical department and has little comprehension of the problems mechanical officers have to solve. If he is never consulted as to the type of equipment which should be built, especially car, he must be connected with a funny organization, in which there is seemingly a lack of co-ordination of effort. His statement that the mechanical department entirely

overlooks traffic consideration is so far from actual facts that I cannot believe he means what he says. As you know, mechanical officers are told by the transportation officers of the service desired and it is then up to the mechanical officers to design locomotives that will satisfactorily perform such service.

Your R. T. O. also seems to think that the mechanical department has only to draw upon all the money in the world to pay for experiments, with all designs of equipment that were ever offered. If he can show his operating officers that short trains of light capacity cars, handled by light locomotives, will net better returns than heavy tonnage trains, I have no doubt the light equipment will be built.

From an Operating Officer.—Where traffic can be accumulated without undue delay and without too much incidental expense for rehandling, it is cheaper to handle it that way, assuming that in any event the train will be loaded so as to permit economical speed over the division. Where the traffic demands operation of small train units there will usually be found sufficient light power to handle it, sometimes freight engines and sometimes passenger engines. Therefore, when new power is needed it is commonly needed because existing power is not heavy enough to handle the trains that can economically be accumulated, and maintain desired speed. Each road must develop for itself the proper trains to fulfill its own traffic conditions. Speed as well as tonnage affects the size of the locomotive.

As to the light four-wheel car, the suggestion is all right from a traffic standpoint, but so far I do not think the four-wheel car is commonly accepted as being safe to operate in high speed trains.

From a Shipper.—May I congratulate you on the article on page 159 of your May issue?

As a shipper, I know it is high time for someone to champion that thought. Most of us are trying to resist using other than rail service, but are forced to do so for the simple reason that in these regards the railroads do not give us the service we require. The small unit with a small minimum, but without increased rates, would solve a lot of difficulties for the shipper and for the railroads. [From J. C. Hormel, president of Geo. A. Hormel & Co., Austin, Minn., the company which is using the four-wheel refrigerator car mentioned in the R. T. O. interview. We are informed by the builder of the car, the North American Car Corporation, that it "has operated over a period of five months, covering a distance in excess of 8,000 miles, and has never caused one minute's trouble or worry since it first went into service." A description of the car will be found in the *Railway Mechanical Engineer*, December, 1932, page 481. See also editorial comment on page 500 of the same issue under the caption "A New Era Brings New Responsibilities."—Editor.]

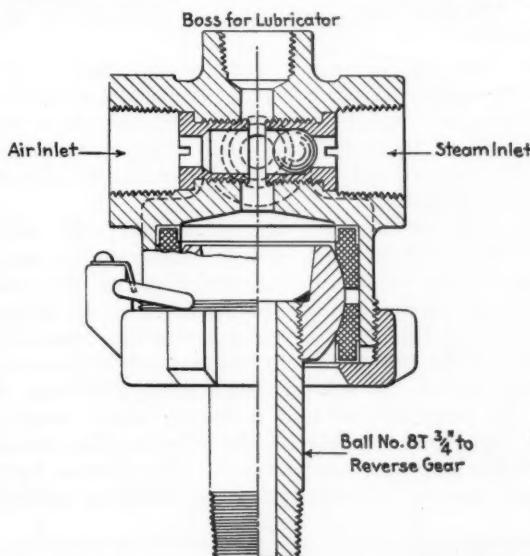
From a Superintendent Motive Power.—I am in accord with his (traffic officer's) views that distribution and merchandising methods require high-speed freight trains, and of course the speed will limit the length of these trains and also affect the type of locomotive to be used. Speed requires power and I do not believe that we need less power but rather a locomotive capable of sustaining high speeds in freight service. Many roads now have a type of locomotive for this service, and speeds have increased until it is a question as to whether the freight equipment as now built can be run at any higher speed. Freight trains are now run at 60 miles per hour and to attain such an operation it requires the properly designed locomotive, which is not necessarily light in weight.

If there should be sufficient demand for a freight car

of ten tons capacity following European practice, I have no doubt but what it would be built; however, it seems to me the container car offers all the advantage of this feature with the added advantage of store-door delivery.

Barco Ball-Check Reverse-Gear Joint

A LARGE majority of the power reverse gears which have been applied to locomotives throughout the country up to the present time are equipped with single inlets required for air operation, whereas a new ruling, recently issued by the Interstate Commerce Commission, specifies that all power reverse gears must now be equipped with separate air and steam supply pipes.



Barco flexible-joint ball-check reverse-gear joint

To assist railroads in meeting this requirement, the Barco Manufacturing Company, Chicago, has developed a new joint, known as the Barco Type 7T-8T, equipped with a heavy forged-steel ball so that no breakage can occur at the threaded end, where it screws into the reverse gear. The casing end is provided with separate air and steam inlets, and a monel metal ball and ball seats between these two inlets. It is further provided with a boss into which the lubricator may be screwed, so that the same lubricator will lubricate the reverse gear with both air and steam.

The I. C. C. requirements are that the reverse gears must be tested with steam at least once every 30 days, and this is generally understood to mean that steam must be shown passing into the valve chamber of the gear but not necessarily into the cylinders, where it would, to some extent, injure the packing. In the Barco joint design, a boss is provided into which a pet cock is screwed so that, in making this test, the simple operation of opening the pet cock will indicate whether or not steam is passing into the valve chamber.

The use of this joint on a power reverse gear eliminates the necessity of providing two separate flexible joints and two line check valves in the air and steam lines, as commonly applied. In addition, one T-fitting, required to accommodate the lubricator, is saved. This construction also saves drilling and tapping the valve chamber for a pet cock, as the pet cock may be screwed directly into the boss provided for it on the Barco joint.

Wind Tunnel Tests of Locomotive Streamlining¹

Part II

By J. J. Green²

THE problem of modifying the external shape of the locomotive was simplified by the realization that improved air and smoke flow goes hand in hand with reduced air resistance. Features on existing locomotives which upset the air flow are the feed-water heater and number lights, the dome, valves and turrets, the poorly shaped front and the exposed valve motion and running gear. All these contribute to the resistance by producing eddies.

The first modifications were made with a view to reducing wind resistance by improving the airflow about the sides and top of the locomotive, and these will be considered in the order in which they were made and numbered accordingly. Fig. 5 shows the wooden model before modification.³

(1) *Side curtains on the locomotive.*—In order to shield the cylinders, valve motion, running gear, etc., side curtains were fitted to the model below the running boards and extended down to the level of the bottom of the pilot (see Fig. 6). These side curtains reached from the pilot to the rear of the locomotive cab and were made of sheet metal. A solid wooden pilot was made to replace the normal type and a sloping sheet metal front extending from the top of the pilot to the bottom of the smoke box was incorporated. The reason for these changes was to prevent air from entering underneath

Modifications of the model as a result of investigations described in Part I led to the development of a new design which provides smoother air flow about the locomotive. By the introduction of a layer of clean air between the smoke and the body of the locomotive, the smoke is maintained above the cab

the locomotive through the pilot bars or just below the boiler. By thus shielding the running gear both by the side curtains and by so closing the front below the boiler as to exclude air, it was hoped that wind resistance could be reduced and a smoother flow achieved for the air passing along the sides of the locomotive.

The wind speeds employed in this and subsequent tests were 20, 40, 60, 80, 100, 120 and 130 ft. per sec., but the average values only of the resistance divided by the square of the wind speed have been presented here. Due

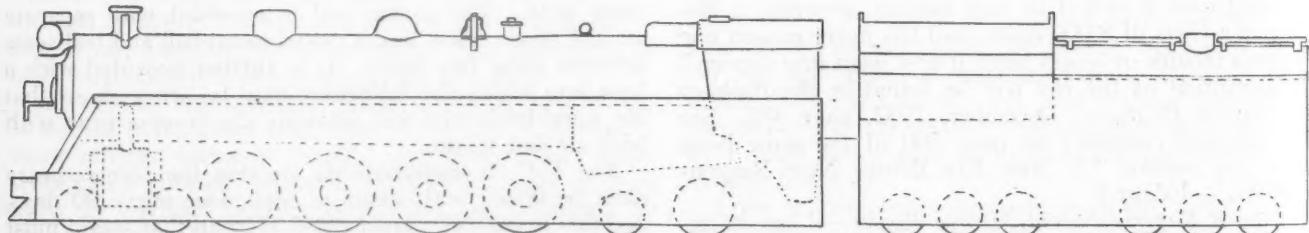
¹Conclusion of an abstract of a paper printed in the January, 1933, issue of the Canadian Journal of Research.

²Junior research physicist, National Research Laboratories, Ottawa, Canada.

³Figs. 1 to 5, inclusive, appeared in last month's issue.

1.

2.



3.

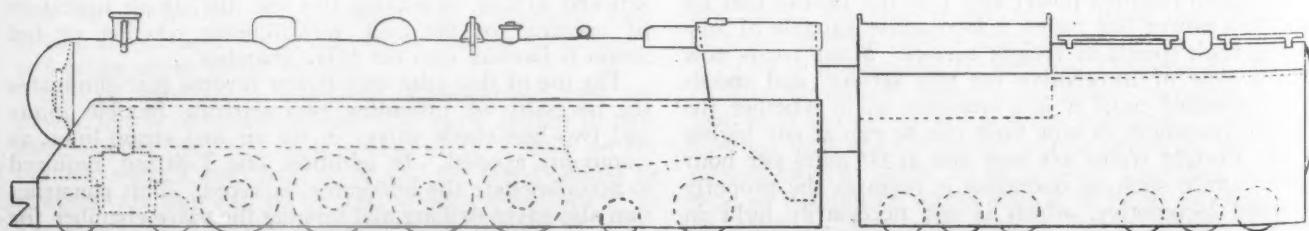


Fig. 6—Drawings of model incorporating modifications 1, 2 and 3

correction has been made for the drag of the vertical suspension-wires but no allowance has been made for the relatively smaller drag of the two inclined bracing wires, owing to the difficulty of correcting for them. In view of their small effect, and since also the tests were designed to measure differences arising from modifications, in which case wire drag balances out completely, this correction was deemed unimportant.

4.

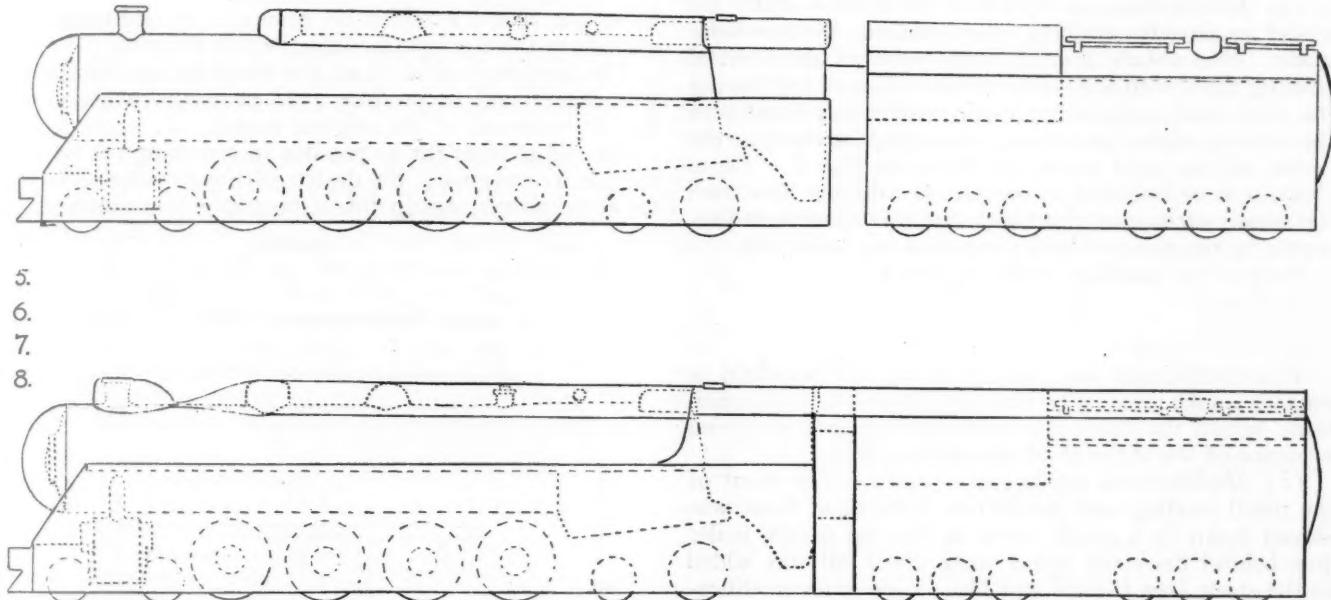


Fig. 7—Drawing of model incorporating further modifications 4, 5, 6, 7 and 8

Drag of original unmodified model R lb. at V ft. per sec. given by

$$\frac{R}{V^2} \times 100 = 0.1089.$$

Drag of model with side curtains on locomotive and solid pilot, etc., as outlined above given by

$$\frac{R}{V^2} \times 100 = 0.1088.$$

At first sight this result was disappointing but it was seen on further consideration that the effectiveness of

$$\frac{R}{V^2} \times 100 = 0.1036.$$

This indicates a greater saving than that effected by the side curtains on the locomotive. This saving, it is argued, would not be so appreciable had the side curtains been absent from the locomotive and would have been greater still had the rest of the model been streamlined.

(3) *Modifications to the boiler front.*—The feed-water heater, headlamp and side steps were removed and an approximately hemispherical front was fitted to the smoke box, otherwise the model was as modified in (1)

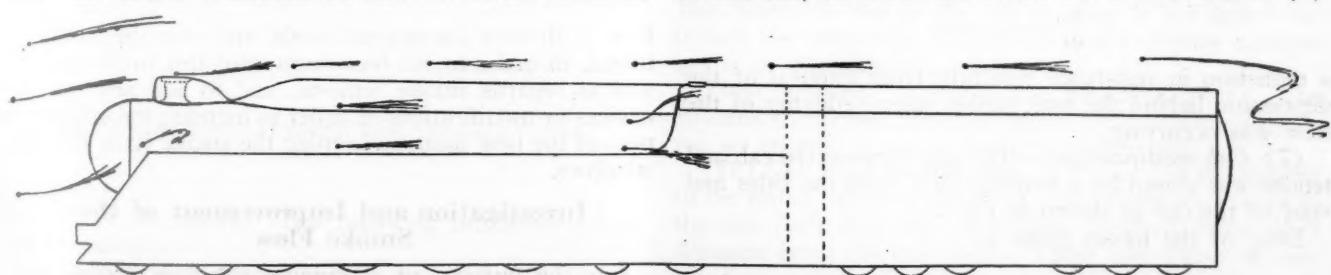


Fig. 8—Type of flow over model as modified in lower drawing of Fig. 7 exhibited by silk threads

any particular modification in reducing resistance would depend very considerably on the extent to which other changes had been already made to reduce resistance. It was argued that adding side curtains to an otherwise unchanged model would produce only a very small change in resistance, whereas their effect on a model which had been carefully streamlined elsewhere would be very considerable indeed. This argument was completely vindicated by subsequent tests.

and (2). A diagram of the model thus modified is given in Fig. 6. The changes were intended to provide smooth flow over the locomotive front and to remove obstructions likely to disturb this flow.

Drag of model given by

$$\frac{R}{V^2} \times 100 = 0.0763.$$

This represents some 30 per cent saving in resistance on that of the original model. The feed-water heater was

suspected of causing considerable disturbance to smooth flow and its removal undoubtedly accounts for part of the reduction in drag. The curved nose on the front of the smoke box ensures smooth flow initially which offsets the disadvantages of bad shape met with subsequently. It is well known that changes to the front of a body have considerable effect on the flow around it and, although this is usually applied to the treatment of streamlined bodies, it appears in some measure to be true of such a poor aerodynamic shape as a locomotive.

(4) *Modifications to the top of the boiler.*—With the model as already modified, the following changes were made. The whistle and bell were removed and a metal cowling flush with the centre of the cab roof and having the same roof contour but vertical sides was fitted over the turrets, valves and dome, extending forward to the centre of the sand dome, as shown in Fig. 7. These changes were intended to remove the eddying flow over the upper surface of the boiler due to obstructions presented by the various items located on the boiler top.

Drag of the modified model is given by

$$\frac{R}{V^2} \times 100 = 0.0710.$$

This modification was expected to be very beneficial as regards smoke removal by introducing smooth flow conditions behind the stack, the reduction in resistance being evidence of the removal of the eddying flow.

(5) *Modifications to the stack region.*—The front of the metal cowling over the turrets, valves and dome was sloped down in a gentle curve to the top of the boiler just behind the stack and a streamlined tail was added to the stack (see Figs. 7 and 19). This latter modification was intended to reduce wind resistance as well as providing what is important from the point of view of smoke removal, *viz.*, smooth flow round the stack and an absence of an eddying region behind the stack.

Drag of the model is given by

$$\frac{R}{V^2} \times 100 = 0.0698.$$

a saving in resistance being effected as anticipated.

(6) *Modifications to the tender.*—A cowling conforming to the cab roof was fitted over the entire tender, with the object of removing the space between the cab roof and the first coach roof caused by the lower level of the top of the water tank. This cowling is depicted in Fig. 7.

Drag of the model is given by

$$\frac{R}{V^2} \times 100 = 0.0666.$$

a reduction in resistance resulting from removal of the depression behind the coal bunker where eddying of the flow was occurring.

(7) *Cab modifications.*—The gap between the cab and tender was closed by a cowling flush with the sides and roof of the cab as shown in Fig. 7.

Drag of the model given by

$$\frac{R}{V^2} \times 100 = 0.0666.$$

Closing in this gap had absolutely no effect on resistance. In view of this fact it appears useless to attempt to reduce train resistance by closing the gap between coaches, and more so, since the air is more turbulent by the time it reaches the coaches.

(8) *Cab modifications.*—As already indicated the slope of the cab front is such as to create a down draught of air at the cab window. To avoid this the cab front was filled in to slope backwards from the running board and the overhang of the cab roof was eliminated. Generous fillets and curves were employed to eliminate

corners and sharp edges, and a generous smooth curve between running board and cab front was considered necessary. This modification is shown in the lower drawing of Fig. 7. It was intended that air taken from the sides of the boiler above the running boards should be shot upwards in front of the cab windows to keep them clear.

Drag of the model was found to be given by

$$\frac{R}{V^2} \times 100 = 0.0620,$$

indicating that a considerable reduction in resistance results from these simple modifications to the cab.

The combined effect of all the foregoing modifications was thus found to produce a 43 per cent reduction in the air resistance of the original model.

Having gone as far as possible in removing the smoke trouble by improving the design of the locomotive from an aerodynamic standpoint, it remained to examine the

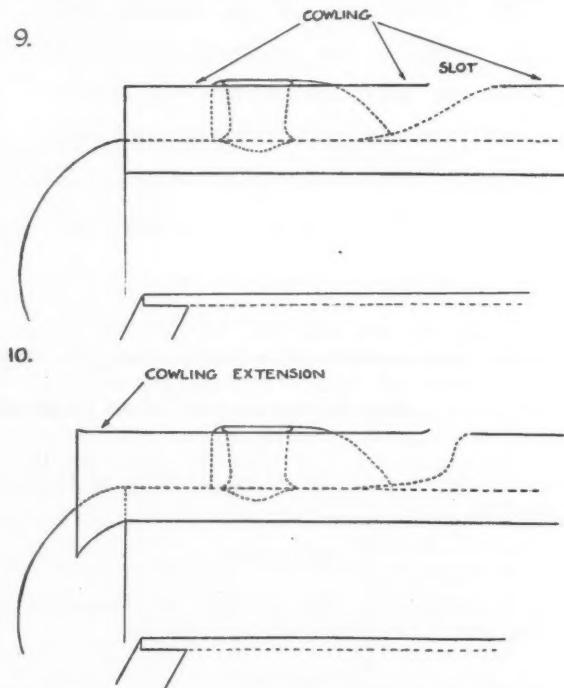


Fig. 9—Drawings of model incorporating further modifications 9 and 10

flow of air over the original model and over the modified model, in order to see how successful this improvement was as regards smoke removal, and to add any special devices or modifications in order to increase the effectiveness of the new shape in keeping the smoke from the cab windows.

Investigation and Improvement of the Smoke Flow

For the purpose of examining the flow around the model a number of methods were considered before the final decision to use silk streamers was made. The use of titanium tetrachloride for exhibiting the flow and allowing photographs to be made would have been ideal but for the fact that the corrosive vapor formed by it could not be tolerated. The use of metal sheets painted with kerosene and lampblack placed round the model in the plane in which the flow is to be investigated was considered but not employed, owing to the inevitable distortion of the flow by the metal sheet coupled with the fact that only the flow adjacent to the metal sheet is exhibited.

In two of the illustrations the flow of smoke from the stack of a C.N.R. 6100 locomotive is shown when the locomotive is drifting. It can be seen from these photographs how the smoke clings to the top of the boiler and blows down round the cab window.

Fig. 2 is a photograph of the original wooden model set up in the wind tunnel with silk streamers attached. The wind speed was 45 m.p.h. and the directions of the air currents around the model are indicated by the disposition of the silk threads.

The following deductions are clearly indicated by the photograph:—

(a) The large eddy behind the smoke stack, caused partly by the feed-water heater, traps the smoke from the stack in the manner shown by the streamer attached to the top of the stack.

(b) A region of eddying flow occurs behind the dome, turrets, etc., on top of the boiler, shown by the streamers attached to these portions of the locomotive.

(c) Considerable downward flow occurs along the boiler sides, exhibited by the streamers attached to the side of the boiler at the dome and at the bell.

(d) A considerable down draught of air occurs at the cab window, shown up clearly by the two threads attached to the boiler side at this position.

In Fig. 8 a drawing has been made of the air flow around the partially modified model as exhibited by the

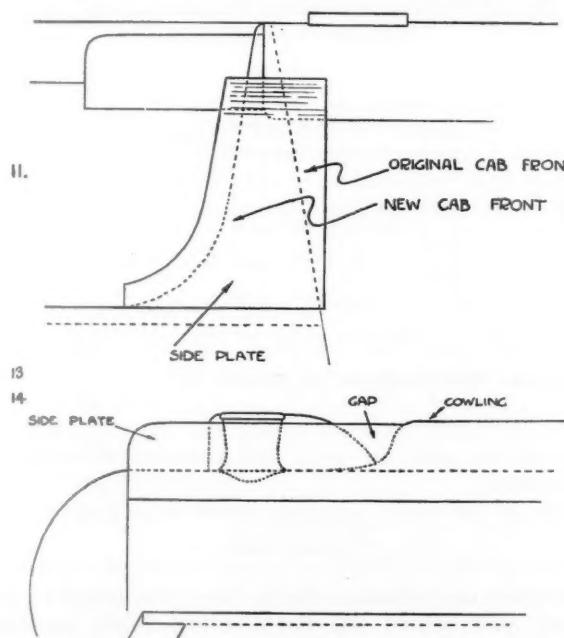


Fig. 10—Drawings of model incorporating further modifications 11, 13 and 14

use of silk streamers. The following important points are indicated:—

(a) There is no eddy behind the stack; the thread from the top of the stack trails out behind with a slight upward trend.

(b) Steady smooth flow conditions exist over the top of the boiler.

(c) There is no downward flow along the boiler sides.

(d) The flow over the cab window is mainly upwards although slight downward flow occurs where the cab front meets the running board, and a slight tendency exists for the air to spill round the sides of the cab.

It is obvious that the flow over this model represents a considerable improvement over the original type of flow, although room still remains for improvement at the cab

and at the stack if the smoke is to be positively lifted clear of the locomotive.

Special Modifications for Removing the Smoke

(9) *Changes to stack region.*—In order to keep the smoke layer from blowing down into contact with the top surface of the locomotive, an attempt was made to collect a volume of pure air from in front of the stack and to discharge it behind the stack, underneath the smoke layer. The first attempt to do this was made by extending forward the cowling which covered the dome, turrets, etc., so that it reached past the smoke stack to the front of the boiler where it was left open to catch air. The smoke stack just protruded through the top of this cowling and a slot was cut in this new portion of the cowling where it butted on to the old cowling in order to allow exit for the air caught in front of the stack. These changes are shown in Fig. 9 (upper drawing),

This arrangement was only moderately successful. The smoke layer was indeed lifted by the introduction of

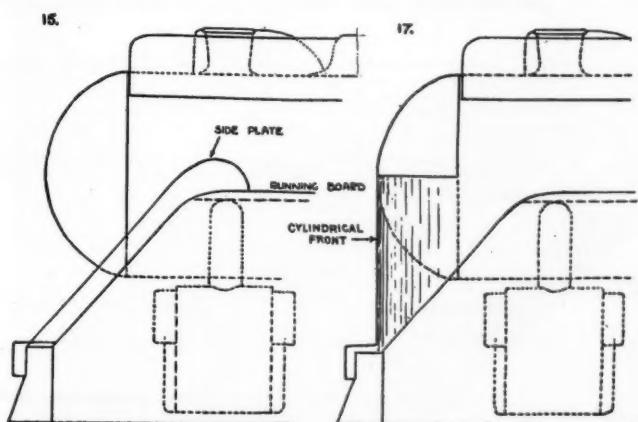


Fig. 11—Drawings of model incorporating further modifications 15 and 17

a clean air layer between it and the locomotive, but not to the extent desired.

(10) In order to catch a greater volume of air the cowling was extended forward some two inches and its sides dropped down to the rounded nose of the boiler as shown in the lower diagram of Fig. 9. The two sides of the cowling were opened out to give a flared entrance. The rear surface of the slot which ran in a smooth surface from the top of the old cowling to the boiler top behind the stack was modified to give a greater upshoot to the air discharged from the slot.

These changes produced an improved flow. The streamers indicated the existence of a very strong ascending air current from the slot behind the stack.

(11) *Cab front modifications.*—To prevent the spilling of air round the sides of the cab, side plates were fitted to the cab such that they protruded forward some short distance from the cab front. These side plates in conjunction with the boiler sides formed scoops in front of the cab windows (see Fig. 10), which functioned by shooting the air upwards over the windows. These side plates improved the flow by eliminating both the slight down trend of the air near the running board and the spilling round the cab sides.

It was felt that the flow over this model was satisfactory and a series of measurements of its wind resistance were made at various speeds to see what effect these changes had made on drag.

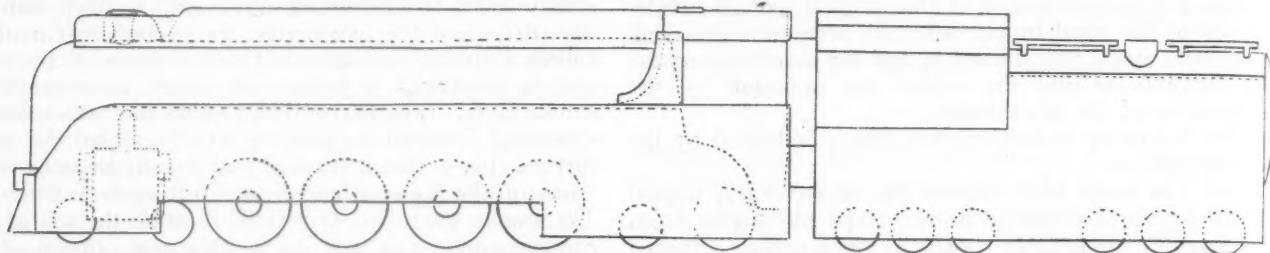
The results gave a mean value of

$$\frac{R}{V^2} \times 100 = 0.0727.$$

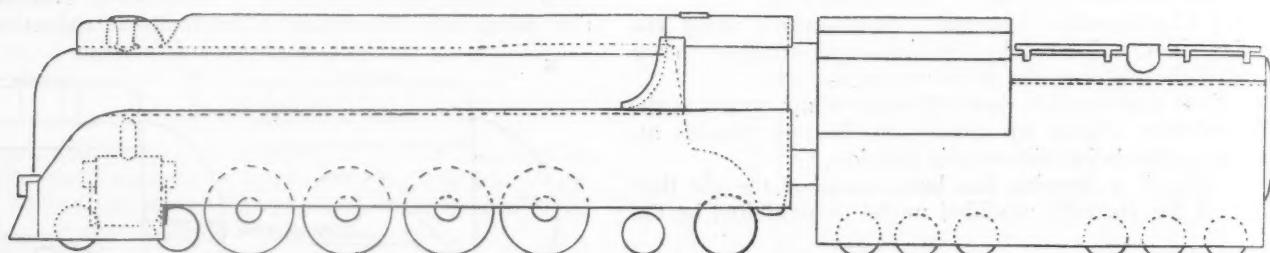
It is evident that the special modifications made to lift the smoke at the stack had considerably increased the air resistance of the model. It was assumed that the extension to the cowling had disturbed the flow over the

fied by removing the roof of the cowling forward of the slot as in Fig. 10 (lower drawing). The idea here was to remove the interference of the roof over the passages on either side of the stack. It was felt that it merely

19.



20.



21.

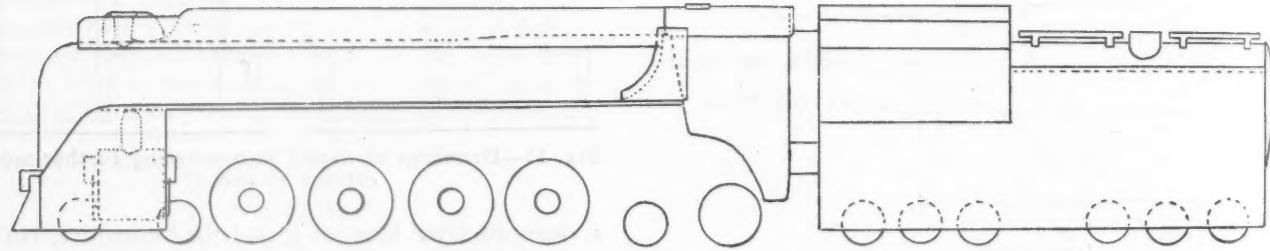


Fig. 12—Drawings of model incorporating further modifications 19, 20 and 21

round nose of the model and caused the sudden rise in resistance.

(12) Accordingly the model was changed by removing the 2-in. extension added in (10).

Drag of the model was then given by

$$\frac{R}{V^2} \times 100 = 0.0685.$$

(13) Leaving the sides of the extended cowling untouched on either side of the stack, the model was modi-

retarded the pure air layer and contributed nothing to the scheme.

Drag of the model was then found to be given by

$$\frac{R}{V^2} \times 100 = 0.0665.$$

With these modifications the air flow was found to drop slightly just behind the stack before finally ascending over the cowling.

(14) The length of the gap between the streamlined

22

23.

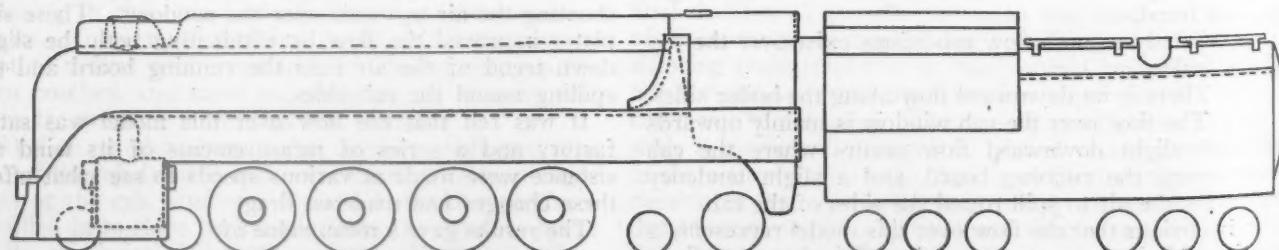


Fig. 13—Drawing of model incorporating further modifications 22 and 23

tail of the stack and the curved surface leading to the top of the cowling was reduced in order to remove the sudden drop of the flow just behind the stack. This was successful. Fig. 10 (lower drawing) shows this modification.

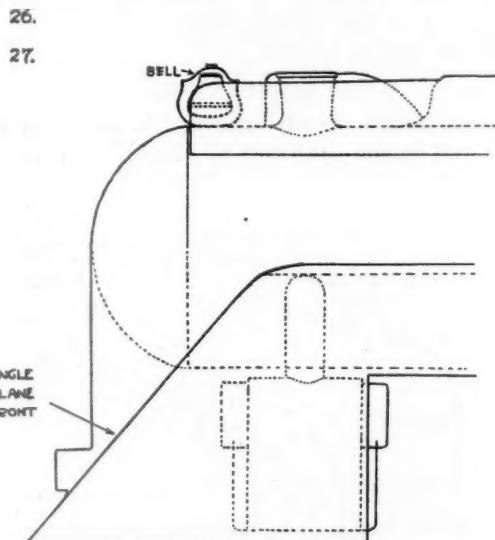


Fig. 14—Drawing of model incorporating further modifications 26 and 27

(15) The front ends of the running boards were rounded off to remove the eddies formed by the sharp corners and side plates were added to act as scoops, as shown on the left in Fig. 11. This improved the flow, lifting it all along the boiler sides, but the resistance was increased.

Drag of the model was given by

$$\frac{R}{V^2} \times 100 = 0.0798.$$

This large increase in drag was caused by the side plates giving rise to large eddies in the flow round the sides of the model.

(16) Removed side plates, running boards left rounded at their front ends.

The drag is given by

$$\frac{R}{V^2} \times 100 = 0.0654,$$

restoring the resistance to a figure approximately the same as that before the addition of the side plates at the front ends of the running boards.

(17) *Changes to the boiler front.*—A cylindrical surface was added between the rounded nose of the boiler and the sloping front, as shown on the right in Fig. 11. The intention was to provide smooth flow con-

ditions for the air entering the space above the running boards along the boiler side.

Drag is given by

$$\frac{R}{V^2} \times 100 = 0.0647,$$

indicating a slight reduction in air resistance due to smoother flow conditions.

(18) *The tender.*—In view of the operating restrictions cited in the introduction the tender could not be fitted with a cowling over the water tank, and runways had to be left at the sides of the coal bunker. A cowling conforming to the cab roof was left over the coal bunker.

Drag of model was then given by

$$\frac{R}{V^2} \times 100 = 0.0633.$$

(19) *Side curtains.*—Operating restrictions will not at present tolerate the complete closing in of valve motion, cylinders, running gear, axles, etc., and for this reason the side curtains had to be cut down in size to leave exposed the several places where inspection and servicing are required. To examine the contribution of side

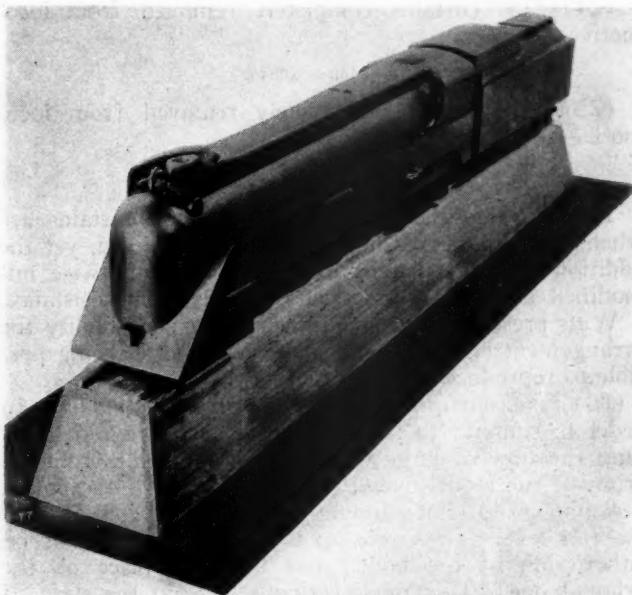


Fig. 16—Model as finally modified, oblique view

curtains to the saving of resistance, this cutting down of their size was done in stages, the results being as follows:—

Full-size side curtains,

$$\frac{R}{V^2} \times 100 = 0.0633.$$

Side curtains cut off below the level of the centres of the driving wheels and from behind the cylinders to the

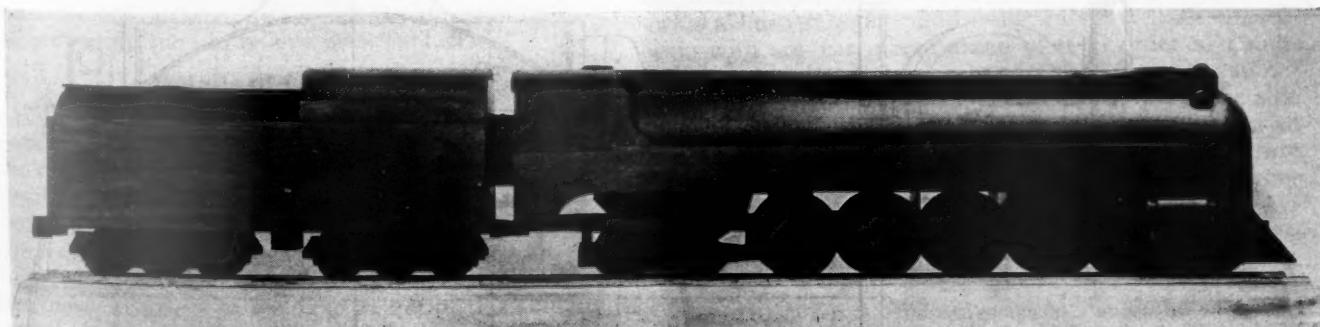


Fig. 15—Model as finally modified, side view

ultimately swept upward in front of the cab windows. The modifications have been made with the idea of reducing turbulence and eddying and thereby cutting down the wind resistance as shown by the following results.

R

The value of $\frac{1}{V^2} \times 100$ has been reduced from 0.1089 to 0.0706, a reduction of some 35 per cent.

The feed-water heater has been placed in a new position as a result of considerations made by the Canadian National. This position is just ahead of the stack and partly lowered into the smoke box as shown by Fig. 18, and Figs. 15 and 16.

From the top surface of this feed-water heater, a

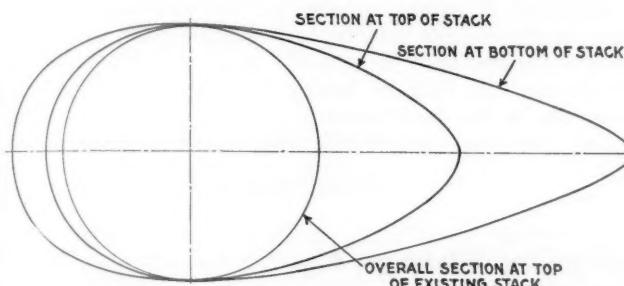


Fig. 19—Section of streamlined smoke stack

level platform is taken back on either side of the stack and runs in a smooth curve into the cowling, over the dome and turrets.

The photograph on page 154 of last month's issue shows the silk streamers on the new model suspended in the tunnel with an air speed of 45 m.p.h. It forms an interesting contrast to the flow picture, Fig. 2, taken at the same speed with the original model.

The lifting of the smoke at the stack is clearly indicated by the streamers and the good flow over the top and sides of the boiler can be seen. The upward current of clean air over the cab window is also indicated.

Fig. 17 shows the developed model and indicates by letters the additions that must be made to existing types of locomotives to convert them to the improved type.

Application has been made for patents on the new design.

Two Aluminum Passenger Cars On Exhibit at Chicago

(Continued from page 191)

In the parlor section, the same general architectural design is used as in the coach section, but the column cornices and individual lighting ducts or frieze present a polished black surface, with polished aluminum moldings and projecting stars to relieve these surfaces.

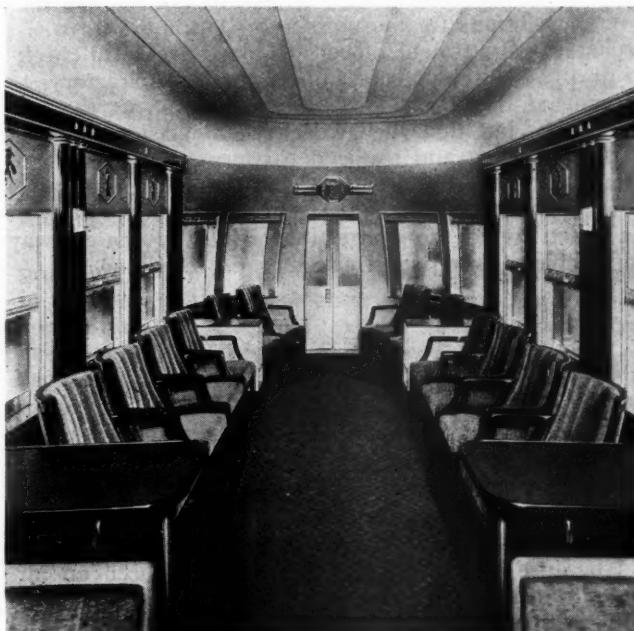
Details of Construction

With the exception of certain details peculiar to the coach type of car, the construction of this car is, in general, similar to the Pullman observation-room car described in the first part of this article. The four-wheel trucks are of the built-up type, with pressed aluminum side frames, designed especially with a view to easy riding. Rubber cushioning is used at several points in the trucks. Because of the light weight of this aluminum car, the designers found it possible to use axles with $4\frac{1}{4}$ -in. by 8-in. journals with 33-in. rolled-steel wheels.

The underframe, with the exception of a straight-line center sill, is of the same general design as the sleeping car and is built entirely of strong aluminum alloy shapes and pressed sections. The couplers and draft gear are similar in principle to those used on the sleeper.

The platform arrangement is based, first, on increased protection and smoothness of action under impact and coupling; second, elimination of noise, and, third, reduction of air drafts prevalent on vestibule platforms with the consequent snow, dirt, etc.

These objectives are accomplished by use of the rubberized draft gear and buffering devices mentioned; also the side and center buffer stem construction. Diaphragm face plate noises are overcome by counterbalanced springs which positively support these members, holding them in an upward position, rather than permitting them to work up and down. A special type of hinged foot plate and one-fold diaphragm, in contact with the foot plate and used in conjunction with thoroughly weatherstripped trap doors and vestibule side doors, prevents draft and the consequent infiltration of snow, cinders



Seating facilities and decorative treatment in the parlor section

and dirt. All moving parts underneath the underframe portion of the car have been thoroughly cushioned by the use of rubber devices to kill sound and stop vibration.

The car is of relatively low height so that its body contour will mate in readily with a self-propelled unit, or with other cars, at the same time providing ample head room and space within the car body. The rear end is streamlined, the front, or vestibule end, being made with a flush side door and designed for a flush connection with any car placed ahead of it in order to reduce wind resistance. Provision has been made for the subsequent extension of the side-girder sheets below the side sills in the form of a skirt, if desired, thus providing an additional streamlining effect. Ventilators also are streamlined and all contours are smooth and true; contributing to the general appearance of the car, the exterior of which is scratch brushed and waxed to give a silvery satin finish.

THE DELAWARE & HUDSON established a record of 561,559 miles per hot box during January of this year, and 875,899 miles during February.

EDITORIALS

Freight Cars Must Be Designed To Ride Better

Aside from the question of the use of lighter, high-speed locomotives and smaller cars for handling l.c.l. and light freight movements, one other problem has been brought squarely to the front in the controversy over the views expressed in the interview with the railway freight traffic officer reported in our May number. There is now entirely too much damage done to the lading in freight cars because of shocks and vibrations, and in the attempt to overcome this too much effort and expense are involved in the packaging of freight shipments. Better riding of freight cars is imperative if competition with motor carriers is to succeed. Fortunately research on the part of equipment supply manufacturers has discovered solutions to this problem. It is now up to the mechanical-department officers to make a careful check-up of these developments and, if found satisfactory, to recommend their adoption. In such an effort there is little doubt but that they will have the hearty support of the operating and traffic departments—at least there is an indication of this attitude in the statements made by an operating officer and a traffic-department officer in the reactions to the suggestions made by the railway traffic officer, as reported elsewhere in this issue.

Inventories Reduced

The striking reduction in railway inventories which has been made, particularly within the past year, is of dual interest to railway mechanical officers because of the direct bearing which this reduction has on their work and because in many instances they have been an important factor in effecting the inventory reductions with attendant savings to the railways.

It is estimated that the railroads of the United States had an inventory of \$320,050,000 of unapplied stock on January 1, 1931, and that since that time a further reduction of approximately \$10,000,000 has been made. The first figure mentioned is a reduction of \$59,492,000 over that of the previous year and \$477,217,000, or over 58 per cent, less than the working capital tied up in materials at the end of 1920 when inventories amounted to \$766,267,000. These striking reductions in inventory have been accomplished, of course, by reduced consumption and declining prices during the past decade, supplemented by a vigorous and sustained drive on the part of railways through well-organized supply departments assisted by the effective co-operation of the using departments.

Some of the most important items of maintenance-of-equipment supplies on hand for Class I railroads as of January 1, 1933, were locomotive and car castings, \$19,300,000; wheels, tires and axles, \$18,300,000; locomotive and car forgings, \$10,400,000; lumber, \$6,250,000; electrical materials, \$5,600,000; boiler tubes, dry pipes, etc., \$4,600,000; bolts, nuts, washers, etc., \$4,550,000. Air-brake material on hand was valued at \$4,370,000; car and locomotive springs, \$2,400,000; passenger-car trimmings, \$2,050,000; etc.

So little repair work, relatively, was done during 1932 that some roads were left with stocks which, on the basis of current consumption, would last several years. The possibility of still further reducing these stocks by making sure that they are used at all points where needed and, in some cases, possibly adapted to other uses than those for which they were purchased, constitutes an opportunity which the equipment maintenance forces have of co-operating with the supply departments in saving money for the railroads. Inasmuch as the coming months will undoubtedly see maintenance operations increased, mechanical-department officers can also help by letting the supply departments know just as far in advance as possible of the materials needed for any projected programs of maintenance work.

Sizing Things Up From the Inside

Last month we inaugurated a series of interviews with railroad officers outside the mechanical department, on the possibilities of that department—in other words, trying to see ourselves as others see us. This month we publish the first of a series of interviews with men inside the mechanical department, commenting on some of its special problems. It was not our deliberate intention to start this series with an interview on the apprenticeship or training problem. Indeed, we had scheduled that subject well down the list; that is, until we more or less casually bumped into the man with the message. It was only then that we fully realized the emergency of the situation. The apprentice instructor in the interview cites three strong reasons why it is more important than ever that we restore up-to-date apprentice training methods at the earliest possible moment—indeed, it appears that there is much that can be done even under present conditions to conserve the value of this work. What do you think of the suggestions made by the apprentice instructor? Now is the time for those of you who have benefited from modern apprenticeship methods to take up the cudgels in their behalf and see that they are not lost sight of in the midst of the baffling problems with which we are now faced.

Breakers Ahead!

Many significant things have been taking place in recent months. Steadily, if almost imperceptibly, the trend of business has been picking up. The gap between the weekly car loading figures, as compared to those of the previous year, for instance, has been closing for about eight months, except for a period during the bank moratorium. Recently the car loading curve and the electrical production curve for the current year crossed above those of 1932.

Drastic reductions of maintenance expenses on the railroads for the past three years have piled up a veritable mountain of deferred maintenance. Past depressions indicate that as conditions better at the end of a

depression, car surpluses are quickly converted into car shortages. While the current records indicate a large surplus of cars and locomotives in good condition, contact with men on the firing line and intimately in touch with the equipment, indicates that these paper figures are far from an accurate gage of the real conditions.

Always at the end of a depression the railroads have been seriously embarrassed with bad equipment conditions. It looks very much as if they were headed for a similar disaster. Now is the time for mechanical department officers frankly to acquaint the executive officers with the exact facts about the equipment and its condition, and to suggest concrete programs which should immediately be set in motion to put the equipment in proper shape to meet the requirements that will be made upon it in the near future.

Unintelligent and Unjust Criticisms

The report of the Coolidge Committee, excellent as it was, contained one statement which can hardly be justified. "Nevertheless," it stated, "it cannot fairly be said that railroad advance in applied science is abreast of that in other industrial fields. For example, the improvements in Germany with stream-lined Diesel and electric trains of very light tonnage, maintaining schedules of 96 miles per hour to offset motor transport, have no counterpart here. The committee has not found it practicable to make exhaustive studies of this subject, but," etc., etc.

The German train is of an experimental design and there is some question as to whether it will fulfill the expectations of its builders under actual service conditions. The announcement of the placing of an order by the Union Pacific for a three-car, stream-lined articulated train, capable of a maximum speed of 110 miles an hour, has attracted widespread attention. One newspaper cited it as an answer to the criticism of the lack of research in the Coolidge report. Such comment is, of course, ridiculous. The Union Pacific project has undoubtedly been under consideration for a long time—certainly long before the Coolidge Committee report was written.

Would it have been possible to build this train much before this time? Undoubtedly, no! The new design requires a combination of extremely light, high-strength materials, stream-lined design and an adequate power plant. The railways and railway equipment companies have done considerable experimenting in recent years with the light, high-strength materials and much progress has been made in the past year or two in the perfecting of these materials and their application to railway equipment. The rapid development of the airplane, with the urge for higher speeds and greater efficiency of operation, has in recent years focused attention upon streamlining, and intensive research in that field has more recently been carried over into the railroad field, where, of course, it is not of such relative importance.

The general introduction of the rail motor car was slowed up for a long time because of the difficulty in developing suitable engines. It is true that units as powerful as those specified for the Union Pacific train have been in use for the last few years, but without the lighter materials and the stream-lining, it is doubtful if the power requirements could have been met even at this time.

All things taken into consideration, therefore, it would appear that railway managements are about as pro-

gressive and place as much reliance upon scientific research as do those in other kinds of industry. This fact, however, will have little effect upon a large part of our population which has little understanding about railway practices but whose favorite indoor sport is to dogmatically tell how they should be operated.

High Thermal Efficiency

On another page in this issue appears a description of the fourth in a series of locomotives developed by the Delaware & Hudson in an effort toward a progressive increase in thermal efficiency. In the matter of steam generation this locomotive does not differ materially from its three predecessors in the series. It carries a boiler pressure of 500 lb. per sq. in., which is the same as that of the last of its three predecessors. In the matter of steam utilization, however, it involves, so far as is known, the first attempt at the employment of triple expansion in locomotive service. An overall thermal efficiency from the coal as fired to the drawbar of 12 to 13 per cent is anticipated under the same road-test conditions under which the thermal efficiencies of the three predecessor locomotives have been established.

The complete departure from precedent involved in the employment of the triple-expansion principle has required the utmost ingenuity in the selection and development of many of the details in this locomotive and many problems had to be solved which would not have existed in the design of a locomotive which conformed to the conventional single-stage expansion principle. Probably the most interesting of these are the use of a corrugated high-pressure steam pipe which provides for expansion flexibility without slip joints; the use of two pairs of cylinders driving on a single pair of main crank pins, and the use of poppet valves driven by a rotary-cam gear. None of these developments would seem to possess inherent difficulties in the way of their success. Corrugated pipes have been used in other fields; poppet valves driven by the rotary-cam gear have been extensively used on the continent of Europe. There is less precedent for coupling two cylinders to one crank pin; the two crank pins are under a heavy combined load, but not higher than has been employed before, with a single pair of cylinders.

To those who are inclined to question the apparent complication and multiplication of parts in the design of this locomotive, it should be pointed out that something of this kind is involved in any attempt at utilizing boiler pressures much higher than those now generally accepted. Any attempt at material increases in pressures without increasing the number of expansion stages is impracticable. The triple-expansion locomotive marks an attempt to attain the utmost in cylinder efficiency from a moderate raising of the pressure range.

Assuming that the locomotive proves entirely successful mechanically—that is, that the new design presents no undue operating or maintenance difficulties—its ultimate economic value will depend upon the relation between first cost of the locomotive, the effect of doubling the number of cylinders and related parts on the cost of maintenance and the comparative cost of maintenance of a valve motion which, in this country, is yet an unknown quantity, and the value of the saved fuel at the relatively low prices prevailing in America.

In general, other economic factors under American conditions command more attention than fuel efficiency. The general improvement in fuel economy which has

been effected during the past decade has reduced the fuel bill to a point where locomotive maintenance has assumed greater relative importance. Furthermore, highway competition is effecting numerous changes in operating practice. The locomotive of the future must meet demands not only for high tractive capacity, but also for the high horsepower capacity needed to move freight at relatively high speeds. The demand is, therefore, not entirely for economy in operation, but for a type of motive power which will help in restoring traffic to the railroads which they have lost to the highways. Where both revenue and economy are involved, getting revenue is the factor which must take precedence.

Where Are We Headed In the Shop?

There are by far fewer railroad shops in the United States than there were five years ago. In the remaining shops there are considerably fewer employees than there were five years ago. That these two facts are true is due not alone to the effects of business conditions. Before the depression started there were definite tendencies toward the concentration of locomotive repair work at the larger central shops with the consequent abandonment of many smaller and outlying shops which, because of obsolete equipment or disadvantageous locations, were not capable of doing their part in the maintenance program. Longer locomotive runs caused the abandonment of many engine terminals, and the tendency toward periodical inspection and repair work caused the closing down of many smaller repair points and the concentration of work at the larger shops. As far as the ability to repair locomotives economically is concerned, there are still repair points representing an excess of shop capacity that could be abandoned in favor of further concentration. The situation as we have it now with respect to repair facilities is merely the result of the accentuation of a tendency due to business conditions which had already gained considerable momentum before the depression started.

For three years mechanical officers and shop supervisors have been forced to direct their efforts in relation to shop policies toward making economies in maintenance work to keep pace with a constantly falling volume of railway traffic. There are many indications at the present moment that the trend of affairs is about to be reversed and that those responsible for maintenance policies will be forced to adjust shop programs to an increasing demand for motive power. We need only look back a little more than ten years to get a pretty clear picture of what may happen. In 1922, discounting even the effects of the shopmen's strike, the railroads experienced a situation where within less than a year the entire railroad picture changed from one wherein an excess of transportation facilities existed to one where a shortage existed. Even with the shop facilities then at the command of the railroads which, measured in the number of shops and the number of employees, was greater than it is today, the railroads were not in a position at that time to keep up with the demand for motive power by the use of their own repair facilities. While it is true that during the intervening decade new shops were built and older shops modernized to some extent, the maintenance facilities of the railroads in this country have not kept pace with the mechanical progress and development that has characterized industry in general.

All of this raises a vital question as to what the main-

tenance policies of the immediate future may be. Will the remaining railroad shops be capable of carrying the load that it seems probable will presently be placed upon them? Will these shops under the new conditions which they are about to face be capable of maintaining modern motive power in a manner consistent with the economies that will be demanded of them in order to assure the railroads of profitable operation in the future? The cost of locomotive repairs represents the largest single item of operating expense of our railroads today in spite of the fact that there has been a consistent reduction in these costs. During the past two or three years it has been almost useless to suggest that certain changes and improvements might be made in the methods and facilities involved in locomotive repair work, particularly if such changes involve investment in new shop equipment. But the time has come when this problem must be faced squarely, or the railroads will have to meet the alternative of rising repair costs in the face of demands for transportation facilities that may be difficult to meet.

The abandonment of obsolete and inadequate shop facilities has been a step in the right direction. Having done this, the railroads must recognize that the larger shops where most of the work is now concentrated will be forced, in the future, to carry a greater load than they have ever carried before. Unless advance preparations are made by strengthening the weak spots in the shop equipment, the supervisors of many shops will find themselves unable to keep up with the demand for power.

NEW BOOKS

ERHALTUNGSWIRTSCHAFT BEI DER DEUTSCHEN REICHSBAHN
(Maintenance Service on the German State Railways). By Dr. Ing.e.H. Peter Kuehne. Published by Verkehrswissenschaftliche Lehrmittel Gesellschaft, M.B.H., Voss. Str. 6, Berlin, W 9, Germany. 538 pages, 238 illustrations. Price, cloth bound, 30 M.

Dr. Kuehne, in co-operation with other railway officers, has written this book in an effort to explain the present standards of maintenance on the German State Railways. Following a short historical review, the idea and purpose of systematic maintenance is discussed, also the relationship between maintenance management and improvements. Chapters III and IV describe the accumulation of work, its distribution, and the size and construction of workshops. Another chapter deals with the principles of the work done in a repair shop, its cost and quality. Chapter VI describes the organization of a locomotive repair shop; Chapters VII and VIII, the modern technical equipments, rules, and plans of work in the locomotive, car, telegraph, signal and other shops of the railway, and Chapters IX and X, approved installations in railway shops and the providing of power for these shops. Chapters XI and XII illustrate the influence of car design on maintenance expense and the importance of standardization. Chapters XIII and XIV are devoted to the management of workshop districts in general and repair shops in particular. In Chapters XV and XVI Dr. Kuehne discusses the maintenance of equipment in operation and gives statistics of the work shops. Important service regulations are given in Chapter XVII and Chapter XVIII deals with man's adaptation to maintenance service and his task. The book contains numerous charts and facsimile reproductions.

THE READER'S PAGE

Why the Difference?

TO THE EDITOR:

Many large shops bore engine-truck and trailer brasses on a horizontal boring mill, but there is a variety of practices at the smaller points. One shop bores them on the vertical boring mill using U-clamps, long bolts and wooden blocking to secure them to the table. Another shop bores them on the vertical mill but uses a special fixture to hold them square and secure. A third shop does this work on a large drill press fitted with a bar with micrometer adjustment cutters. Still another shop uses a homemade horizontal mill built out of an old lathe. The compound rest on this lathe is replaced by a substantial planer chuck, adjusted by the hand cross-feed and fed under the tool by the power feed of the lathe. This machine, although mostly shop built, is well made and is used to advantage on many of the lighter jobs done on the horizontal mill.

Here we have an example of several different ways to do the same job, some very inefficient. A further investigation showed that at some outlying points these brasses were applied without being machined at all. The brasses were poured full of babbitt while held up to the journal on jacks, using the journal itself as a mandrel, and then filed and scraped to a good bearing. The same wide variation in practice is found in connection with nearly every job done in a railroad shop, even in different shops on the same system. It seems to me that a free exchange of ideas among railroad shop men would be of advantage to everyone. Why should such wide variations in practice exist where the same job is concerned?

A READER.

Do Safety Laws Need Amending?

TO THE EDITOR:

When the United States Safety Appliance Law was enacted by Congress on March 2, 1893, and amended on April 1, 1896, it was for the sole purpose of promoting safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with safety appliances which would eliminate certain hazards to employees or passengers when getting on or off cars or to prevent injuries to employees while handling cars in the performance of their duty.

To keep the railroads on the alert the I. C. C. also employs inspectors who frequently visit terminal yards accompanied by either the inspectors, a foreman or other railroad employee, and make an inspection of from 100 to 300 cars. Defects discovered at that time are known as "reportable defects" and the railroad is never penalized for failure on the part of the car inspector to detect them. The railroads usually discipline the employee whose duty it was to find this defect, thereby impressing upon the individual and the other inspectors in that terminal the importance of seeing and correcting any

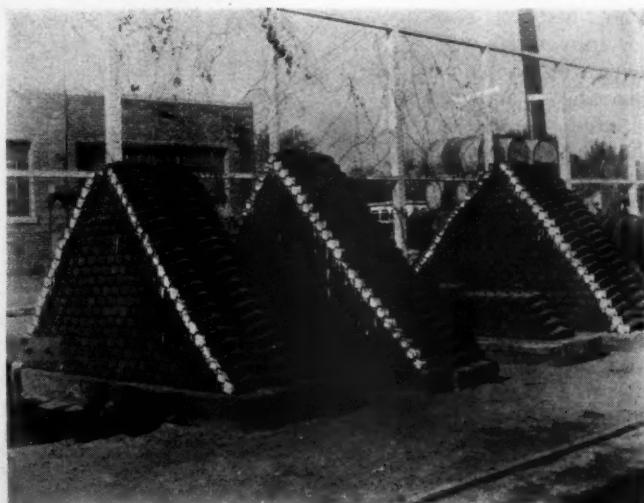
defects that may be discovered on safety appliances.

The railroads are penalized by the I. C. C. when a car bearing a defect is moved from one terminal to another. For each such defect noted the railroad company is subjected to a fine of \$100. A train can have one or more penalty defects and the amount of the fine is, of course, based accordingly.

Usually two I. C. C. inspectors make the inspection for penalty defects and will not, under any circumstances, permit a representative of the railroad company to accompany them. When the case comes up in the United States District Court the railroad must necessarily plead guilty to the offense and pay the penalty. In such cases as this is not the I. C. C. actually disregarding the law in permitting a car having a penalty defect, which the law defines as one liable to cause personal injury to a railroad employee or a traveler, to remain in service?

A case recently occurred where a car was discovered by an I. C. C. inspector with the side handhold loose at the top. The bolt holding it to the car side had the nut missing on the inside. The I. C. C. inspector made a report of the defect to Washington where preparations were made to collect the fine. In the meantime the car was moved out of the terminal where it was found by the inspector. At an intermediate point, after leaving the originating terminal, one of the trainmen had occasion to board this car and in doing so used this defective handhold which, to all outward appearances, was in good condition. It pulled outward and caused the trainman to lose his balance. He suffered a painful but, fortunately, not a serious injury. During the investigation that followed it was discovered that while the railroad company's inspector failed to find and correct the defective handhold, which would have prevented the injury, the I. C. C. inspector did detect it, but he did not call it to the attention of the railroad or have it repaired, resulting in an injury to one of the company's employees.

Possibly we need another amendment to the law.
CAR-KNOCKER.



Brake shoes stored as shown are easy to get at and lend neatness to the storage yard—No blocking is used

With the Car Foremen and Inspectors

Car Inspector— Or Pack Mule?

By H. K. Allen

THE saying "A good workman never complains of his tools" was probably the brain-child of someone who was well acquainted with the amount of equipment that a car inspector is expected to carry about on his job.

We car inspectors cannot afford, nor do we dare complain because of the fact that we must load ourselves down, like a hayburner in a coal mine, with miscellaneous books, instruction pamphlets and other equipment with which to do our work.

Regardless of our experience or our knowledge of current rules and instructions we cannot memorize specific cuts or diagrams in the A. R. A. book of loading rules. When we run across an unusual load we must refer to our loading rule book and satisfy ourselves that the load is secured properly and that there has been no deviation from standard practices. For this and many other reasons we must have a copy of the loading rules in our possession at all times.

The A. R. A. rules of interchange are much more easily remembered. However, there is always the chance that an argument may arise at the interchange track concerning the delivery or acceptance of a car and the rule book is a very handy and convincing article to have along at that time.

Instructions contained in the Tank Car Specifications and the Safety Appliance Manual are somewhat difficult to remember, at least I have found this to be true. It is therefore necessary to carry these along for convenience.

Car inspectors who inspect cars for movement over territories where clearances are restricted must see that all high cars or cars on which commodities are loaded in excess of clearance dimensions are carded properly and the yardmasters and conductors in charge of the trains on which they are to be moved are notified. Cars will also be found that must be re-routed in order to divert them from terri-

tories where there are bridges, tunnels, etc., that will not permit clearance. For ready reference, a copy of the clearance tables must be carried together with a supply of routing or clearance cards one of which must be attached to each side of the car and one given to the conductor in charge of the train so that he can attach it to the waybill.

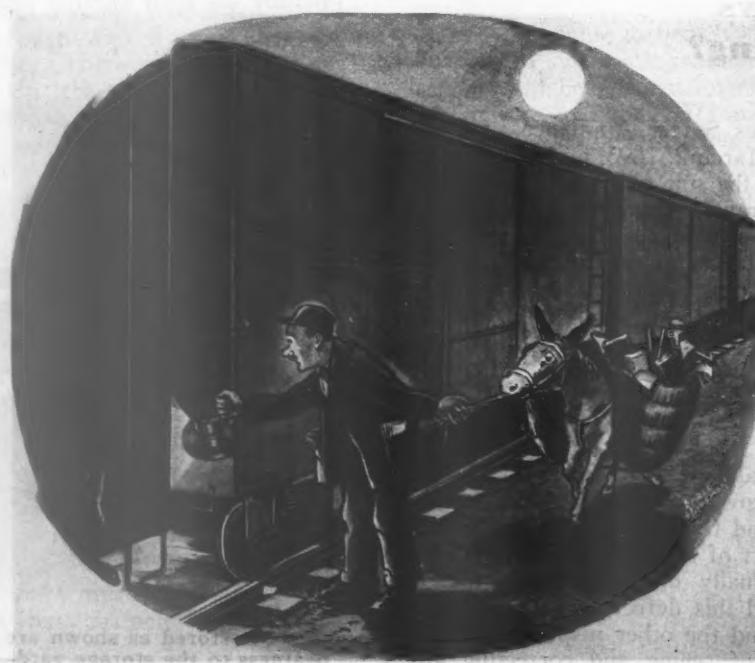
Should it be necessary to make minor repairs to any car which is being inspected, items such as brake shoes, knuckle pins, cotter keys, bolts and nuts must be recorded on a billing repair card in order that the car owner, should the repairs be made to a foreign car, can be billed properly. Then after we complete our inspection of a train an inspection card must be made out for use as a record in the car foreman's office. Here are two more items we must carry.

When cars are being inspected the car inspector must apply either a loaded or empty certification card to indicate that, if empty, the car is suitable for loading without further inspection; if loaded, to certify that the car is free from defects which would prevent its safe movement to destination without a further inspection. In the case of empty cars a careful inspection of the interior must be made and a commodity card applied to each side of the car indicating the commodity for which the car is suitable. This inspection calls for the use of two additional items.

Should a car be found with defects which necessitate shopping it to the repair track a bad order card must be applied. These cards are usually printed on both sides. One side for empty cars and the other for "shop when empty." Then there is another card for loaded cars with the reverse side for "transfer of contents." A supply of these cards must be carried by the inspector

for one of the most important duties he has is that of shopping out bad-order cars or cars that are not in safe and serviceable condition for movement in trains.

On most railroads it is mandatory that a copy of the safety rules be carried on the person of all employees. Car inspectors, belonging to a group of employees whose duties are more or less hazardous, must not only have these instructions in their possession but must be thoroughly familiar with them and ob-



serve them at all times while performing their duties.

In yards and terminals where refrigerator cars are loaded it is the duty of the car inspector to take the temperature of the interior of the car before it is loaded. This he must report on a designated form to the yard foreman or agent. Then too, he must take a record of the position of the vents and plugs and record this information on the same form and for the same purpose.

It is well known that a car loaded with a piece of pivoted machinery must be given an exceptional inspection. This is also true of locomotive cranes traveling on their own wheels. These must be checked closely to see that the swinging portion is secured in accordance with instructions contained in the loading rules, that is, with rods of standard dimensions to prevent any part from swinging out over the adjacent track and causing

What Is on the Mule's Back?

A. R. A. loading rules
A. R. A. interchange rules
Tank car specifications
Safety appliance manual
Book of clearance tables
Billing repair cards
Defect cards
200 inspection cards
Commodity cards
50 Bad-order cards
Railroad safety dept. rules
Refrigerator car reports
Pivoted machinery cards
Hammer
Pencils
12-in. rule
Tape measure

A. R. A. wheel defect gage
Coupler contour gage
Inspector's lamp
Electric flash lamp
Switch key
Thermometer
Packing knife
Oil can
Pinch bar
Air hose, gaskets
1 1/4-in. pipe wrench
1 1/4-in. solid die (pipe)
Chisel
Piece 5/8-in. pipe, 6-in. long
Nuts
Cotter keys
Mirror (hand)

a serious accident. If, after a careful inspection, the load or machine is found to be in proper condition for movement a pivoted machinery card, as shown in the A. R. A. loading rules, must be attached to each side of the car to indicate that it has been inspected and found secured in accordance therewith.

A car inspector without a hammer would be as bad as a ship without a rudder. Likewise he must carry a pencil for use in preparing reports and signing forms. A rule and tape measure for obtaining the dimensions of safety appliances and other parts and for measuring the height and width of cars and lading must be carried.

In obtaining the height of couplers I have found that a piece of ordinary white twine with a weight such as a nut or small bolt attached at each end makes an effective straight edge when thrown across the rail, and eliminates the use of a coupler-height measuring stick.

We must carry an A. R. A. wheel-defect and coupler contour gage. Also a hand mirror for use in detecting flaws or fractures in parts where the light must be reflected or where it is not possible to make an inspection otherwise.

With the exception of those inspectors having a daylight job we must be provided with an inspector's lamp and while this may be attached to the belt when not actually in use its rays must be directed to individual parts of a car. Where it is necessary to make inspection of cars containing explosives or of tank cars containing gasoline or other high volatile commodities it is necessary to use an electric flash light. Not knowing when we will run across such a car, we must carry an electric flash light with us. A switch key for use in unlocking the repair-track switch locks after completing our inspection and a thermometer for taking the temperature of refrigerator cars are among the other miscellaneous articles which we must carry.

I happen to be located in a terminal yard where only one car inspector is employed on each shift, no box packers and oilers, air brake inspectors or repairmen being stationed here. I must make such minor repairs as are found necessary to safeguard the movement of the

cars, inspect and treat the journal boxes requiring attention, test the air brakes and make the final inspection of all cars which are despatched on the eight-hour shift on which I work.

This makes it necessary for me to carry along a packing knife so that I can set up the packing in the journal boxes and an oil can to apply free oil to those journal boxes in which the packing appears to be dry and in need of additional lubrication.

For the reason that many box car doors cannot be opened or closed without the use of a pinch bar and the fact that the bar can also be used to good advantage when repairing brake-beam hangers, etc., I find it essential to have one along.

Frequently, when coupling up air hose it will be found that the gaskets are missing or, when the brake pipe is charged, many leaks develop at the hose connections due to worn air-hose gaskets. A supply of these must be carried.

Where broken brake pipes are found, especially on cars in which perishables have been loaded, it is necessary to make immediate repairs. Therefore a pipe wrench, a 1 1/4-in. solid die and a chisel for gouging out the broken pipe from the sleeve is required.

For spreading cotter keys, especially in draft keys, we are provided with a piece of 3/8-in. pipe, about six inches long, which has been ground off on the end. This is a very handy tool and is much lighter to carry than a chisel.

A few of the smaller size nuts and several cotters and split keys usually find their way to the pockets of the car inspector for there is seldom a train on which he is at work that he does not have need for these things.

Summarizing the different items which we are instructed to carry along we find that the books of A. R. A. rules and other instructions above enumerated, a total of six, will fill up the hip pockets of the trousers very nicely and leave no room for anything else.

Fifty bad-order, or shop cards are usually sufficient to carry along on one trip from the car inspector's shanty so I keep them in the left side pocket of my top-coat. However, I must carry at least 200 certification cards to last me one trip and carry them in the right side pocket of my top-coat. The billing repair cards and inspection records are carried in the inside pocket of my top-coat which accounts pretty well for all of the room available in this piece of wearing apparel.

A canvas vest, provided with four pockets, two near the top and two at the bottom, must be worn to take care of the routing, commodity and pivoted-machinery cards, together with the temperature records.

Now with 19 other items, including a car inspector's hammer, lamp, mirror, etc., strapped to different parts of the body or carried in the hands, we are ready to do a marathon down one side of a 100-car train, take down the blue flag and light and return to the head end, remove the flag, light and switch lock so that the engine can couple on. We are then ready for the terminal test of the air brakes.

At this time the yardmaster comes yelping on the scene and starts wondering out loud, in language used principally by yardmasters, when the train is going to get moving. Another trip must be made to the rear end to see that all of the brakes have applied, then the release signal and the OK from the rear and we start on the next train.

How different we old timers find these days of modern inspection methods from those when it was only necessary to have a hammer, wheel gage, a rule and a lamp together with a handful of bad-order cards!



An Interesting

Repair Job

Described in

Pictures

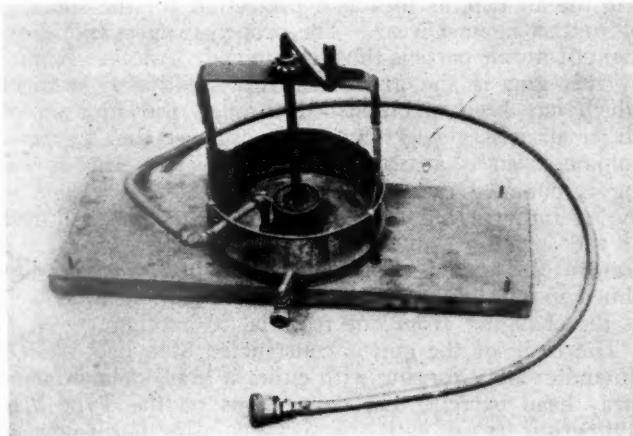
IT is a well-known fact that the lugs cast as an integral part of many types of cast-steel truck side frames which serve as a hinge for journal-box covers are subject to wear in service. After these side frames have been in use for several years it is not uncommon to see these hinge lugs worn all the way through with the result that the covers work loose and are frequently lost. The upper picture of the two shown at the right on this page gives a good idea of the way these frames often look when they are removed from a car for repairs. The General American Tank Car Corporation, Chicago, which operates a number of cars with side frames of the type illustrated, has developed an interesting method of repairing the frame hinge lugs by welding. First, the worn lugs are cut off flush by means of an oxyacetylene torch. New cast-steel lugs are then set in the proper place and electrically welded. The lower picture shows three such side frames with the new lid hinge lugs all ready to be returned to service.



Overhauling Door-Check Springs

PASSENGER-CAR door-check springs become bound with caked dirt and dried oil and it is desirable to clean between the coils. This may be quickly done by means of the device shown in the illustration.

The spring is dropped into the cylindrical socket shown and a crank arm with lug is inserted in it, en-



Convenient device for overhauling door-check springs

gaging the end of the coil spring. A few twists of the crank winds up the spring and opens up the turns. The crank is held in position by a ratchet lock and a jet of steam from the attached hose quickly cleans this spring. It is then dried and oiled and placed in the proper operating position.

Steam Hose Testing Rack

AN actual test under working pressures of steam is the only reliable means for determining the real condition of steam hose. To make such tests, a substantial testing rack, designed to accommodate either rubber or metallic hose, has been developed at one passenger shop, as indicated in the illustration. This particular view shows a metallic hose ready for test.



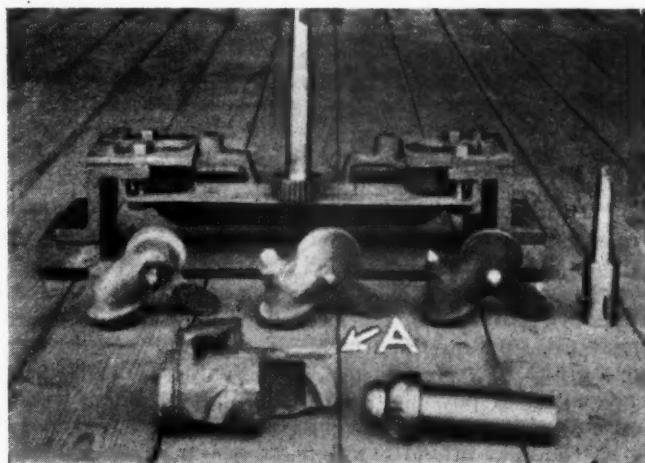
Steam connection and table for the convenient testing of rubber or metallic steam-heat hose

Steam is brought into the shop through an insulated pipe line and shut-off valve and fittings are arranged for quick and convenient coupling of the steam hose. A tee attached to the end valve threads of the hose has a bleed valve to expedite the escape of air, and the small pipe, at the same time, provides a wrench handle for applying and removing the tee quickly.

The steam hose and fittings rest on a special wooden rack covered with sheet iron and having a slight tilt to the rear with a drainboard arranged to carry off any condensation.

Reclamation of Metallic Steam Hose

WITH the widespread use of metallic steam hose on passenger cars, involving higher initial investment than for rubber hose, the importance of economical maintenance becomes of vital interest. It is, of course, not economy to scrap all of the original parts when an



Jig and tools used in reclaiming parts of metallic steam-heat hose

inexpensive repair job will make them serviceable again.

The greatest strain and wear is at the gasket sockets and pivot points. A brazing torch can be used, however, to build these up again when they fall below the condemning limit and an inexpensive reaming operation will re-establish original dimensions. In the background of

the above illustration, an elbow is shown placed in a jig after the interior of the gasket sockets has been built up by brazing. A reamer (shown resting vertically on the jig) is used in a drill press to refinish the socket.

Immediately in front of this jig are three angle units. The one on the left has a pivot pin broken off. The one in the center has a new pin brazed on, and the one on the right has the pivot machined to the proper dimensions by the finishing tool shown beside it. This tool consists of an old drill socket in which a steel cutting edge of proper contour has been fastened so that the machine operation is performed on a drill press.

In the foreground of the illustration is shown a No. 310 head. The portion at *A*, dented by striking with a hammer in coupling, has been built up by welding so that it can be ground off to its original contour. The reamer shown at the right is used to true up the gasket seat.

These four simple jigs and reamers are all the tools necessary to reclaim otherwise scrap parts, and maintain metallic hose in good condition without expensive replacements.

Spray Gun with Simplified Control

IN the Type MB spray gun, which the DeVilbiss Company, Toledo, Ohio, has recently placed on the market, two new features are of interest to spray-gun users: A new air trigger design which insures easier operation, and an improved, unrestricted air passage arrangement which is said to provide better atomization. In the Type MB spray gun it is no longer necessary to exert finger pressure on the trigger of the gun to overcome the tension of strong springs, the "Feather Touch" control making it possible to keep the gun in action without undue strain on the hand of the operator. This ease of operation is provided by an air piston which relieves the spring tension on the fluid needle when the air valve is open. This permits the use of strong spring pressure to close the needle, yet the trigger pull need be only strong enough to open the air valve. The trigger



DeVilbiss type MB spray gun

pull does not compress the strong needle seating spring, this being accomplished by means of air pressure and

without any unusual effort on the part of the operator.

The unrestricted air passage in the Type MB gun permits a greater volume of air in the head, resulting in atomization at a lower air pressure. The air in this gun is distributed evenly in the cap, reducing to a minimum excess fumes and the waste of painting materials. The lower air pressure at which the gun operates contributes to a more even finish.

This gun has an improved ball and cone principle which assures the proper concentricity of the fluid tip and the air cap, as well as a protection for the surfaces of contact against wear. The proper spacing and alignment of nozzle parts is thus maintained. Another feature of this gun is the graduated spray width adjustment which has been accomplished through the addition of larger air passages in the port openings so that a greater volume of air is available at the point where the spraying is done. Graduations which are clearly visible to the operator permit control of the width and character of the spray. The removable spray head, which is a feature of DeVilbiss spray guns, has been further simplified so as to visualize the cleaning of the head as well as the changing from one material to another.

The body of the gun is constructed of a heat-treated aluminum alloy forging with either a brass or aluminum spray head barrel. The connections on the Type MB gun permit its use with any spray-painting outfit now in use.

Hook Link for Connecting Chains

AN indispensable piece of equipment for the wrecking train or for shop use is the "hook link" shown in the accompanying photograph. The hook link can be used any place that the chain hook is used and while there is always a liability of the chain hook slipping due to straightening out this is entirely eliminated by the hook link for the reason that the more strain placed



A link that closes under load instead of opening

on it the more rigid it becomes as it will close instead of opening.

The links are very easily manufactured. A large welded link is placed in a forge and heated sufficiently to form around a piece of round iron of the thickness of

the chain with which it is desired to use the hook link.

Another advantage is that chains on which hooks are attached cannot be forced through small openings whereas with the hook removed the chain can be entered into small openings and both ends fastened after it has been made taut.

These links are useful in chaining trucks to cars or tenders during derailments, for chaining up cars out on the line or for bundling up piles of rail or other scrap.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged Due to Coupler Pulling Out

Shippers Car Line car No. 11558 was damaged in a switching movement on the Texas & Pacific at Browder, Tex., on August 16, 1931. The car was repaired by the T. & P. and a bill rendered against the owner, in amount of \$93.54. The owner contended that the damage was the result of improper handling and submitted as evidence a statement of an eye-witness which indicated that the switching locomotive was handling a cut of 41 cars, 21 of which were next to the engine with the air working, and the other 20 with the air cut out and that the car in question was 31 cars from the engine which was being handled by the fireman who, in making a stop, made an emergency application, pulling the coupler, end sill and side sills out of the car and causing certain other damage to the amount mentioned. The T. & P. refused to cancel the charges as requested and in its statement said that an investigation of the conditions surrounding the damage disclosed the fact that the locomotive was handled at the time by a qualified engineman and that there was no irregular handling, no derailment, or Rule 32 conditions involved. The Arbitration Committee rendered a decision on November 4, 1932, to the effect that "This car was not damaged under any of the provisions of Rule 32 and, therefore, the car owner is responsible."—Case No. 1710, *Shippers Car Line Corporation vs. Texas & Pacific*.

Defect Card for Wrong Size Coupler

On December 23, 1930, the St. Louis-San Francisco requested from the Terminal Railroad of St. Louis a defect card for a wrong size coupler which it claimed was applied by the Terminal to St. L.-S. F. car 125237. Joint evidence executed by the St. L.-S. F. inspector was attached. A billing repair card covering correction of these wrong repairs at Yale, Tenn., dated October 23, 1930, and also T. R. R. A. billing repair card covering repairs made at East St. Louis, Ill., September 17, 1930, were also attached. In an exchange of correspondence the Terminal Railroad definitely declined to assume responsibility, claiming that it had applied the proper size coupler. In its statement of fact the Terminal Railroad said that it had applied a second-hand 5-in. by 7-in. shank

coupler to one end of the car in question on September 17, 1930, and that between then and September 28, 1930, several movements involving the Frisco and other lines had been made without any exceptions being taken to the coupler. It also stated that the first evidence submitted showing the presence of a wrong coupler in the car was dated October 19 at Memphis, a month after the Terminal Railroad had made repairs and after the car had repeatedly moved in interchange to and from the Frisco and other companies without any exceptions being taken and that the first inspection record noting the presence of a wrong coupler showed that there was then on the car a new coupler, whereas the Terminal Railroad had applied the second-hand coupler to the car and so charged it. Under the circumstances the Terminal Railroad stated that it could not see where any evidence had been produced to connect that company with the application of a wrong coupler to the car. The Terminal Railroad cited the provisions of Rule 12, with particular reference to the necessity of obtaining joint evidence within 90 days as the basis for declining to honor the claim. The St. Louis-San Francisco contended in its statement that its inspection of this car at Yale, Tenn., on October 25 disclosed the fact that a non-standard coupler had been applied to the car and joint evidence, properly executed, was signed by a representative of that company and the chief interchange inspector. The wrong repairs were corrected at that point on October 30, 1930. The St. L.-S. F. contended that inasmuch as joint evidence was properly executed and obtained within the time limit and that wrong repairs were immediately corrected, it was justified in rendering a bill against the T. R. R. A. inasmuch as that road had not issued a defect card within 60 days.

The Arbitration Committee, in a decision rendered November 4, 1932, said that: "Joint evidence of wrong repairs is final and claim of the St. Louis-San Francisco is sustained. Decision No. 1626 is parallel."—Case No. 1711, *Terminal Railroad Association of St. Louis vs. St. Louis-San Francisco*.



Rivets driven with a pinch-bug type of riveting machine at the Milwaukee (Wis.) shop of the C. M. St. P. & P.

In the Back Shop and Enginehouse

Running Floating Bushings Successfully

By G. Dempster*

THE successful running of floating bushings in main rods and main connections of side rods has been more or less a problem and, although many railroads, especially the larger ones, have solved the problem and are running them successfully, some, after trials, have discarded them as impracticable while some are still having their troubles.

New locomotives with 24-in. by 28-in. cylinders, carrying 200 lb. of steam, superheated, and equipped with floating bushings in the back ends of main rods and main connections of side rods, were purchased from the builders several years ago by the Alabama, Tennessee & Northern. The life of these bushings varied from 4,000 to 18,000 miles, with an average of about 10,000 miles. Failure after failure occurred on account of the bushings cracking or breaking into pieces, causing a heavy expense for renewals, to say nothing of the delays to trains.

The manufacturers of the bronze castings from which the bushings were made and the builder of the locomotives were called upon for relief. At the suggestions of both, a change was made in the design from a grooved to a perforated bushing and a higher grade of bronze used, but still with far from satisfactory results. The builders finally furnished a new set of tough steel bushings and a set of special bronze bushings and an engineer to supervise the installation. It was necessary to renew the main-rod bushings after about 25,000 miles and the side-rod bushings after about 35,000 miles on account of being worn beyond the limit allowed by the federal inspection rules.

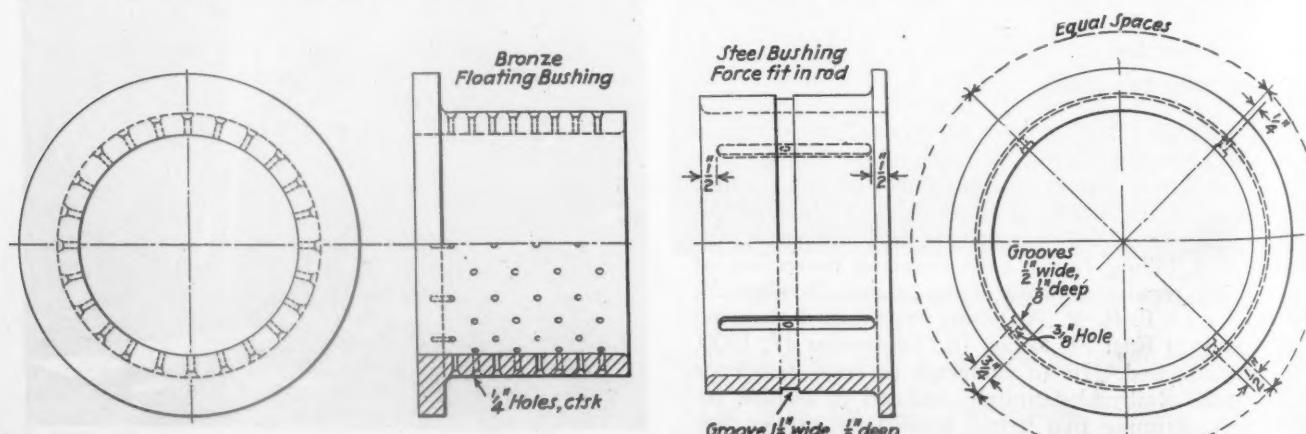
On the bushings that had failed and those that had worn out after unsatisfactory mileage, abrasions were found inside the bore while the outside was perfectly smooth, which indicated insufficient lubrication on the inside.

* Master mechanic, Alabama, Tennessee & Northern.

The following method of preparation as used by some other railroads was tried, but did not prove entirely satisfactory. The outer bushing (of steel or gun iron) had, on the outside, around the bushing, and connecting with the hole from the grease plug, a groove, $1\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep. On the inside of this bushing were four grooves, $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. deep, equally spaced and extending across the bushing to within $\frac{1}{2}$ in. of the ends, every groove being connected with the outside groove by a $\frac{3}{8}$ -in. hole. The bronze bushing was perforated with $\frac{1}{4}$ -in. holes in rows around the bushing, these rows being from $\frac{3}{4}$ -in. to 1 in. apart, with twelve perforations to the row, alternate rows being staggered. This left, across the bushing between perforations, 24 blank spaces $\frac{3}{4}$ in. to $\frac{1}{8}$ in. wide, and as the groove inside the steel bushing was only $\frac{1}{2}$ in. wide, it can readily be seen that should the groove come directly over the blank space when the grease plugs were screwed down, no grease could reach the inside of the bronze bushing. This would allow the bronze bushing to become dry on the inside, causing a hot and cut bushing, the expansion possibly causing it to become tight in the steel bushing, losing the benefit of the floating feature and the life of the bushing being materially shortened. Blanking the grooves could occur as readily with the four equally spaced grooves as they would divide equally in the 24 equally spaced blank spots and, should one groove be blanked, all would be blanked.

The method as finally adopted was as follows: in laying out the cross grooves inside of the steel bushing the bushing is divided into four equal parts, the first groove is made central with the line as laid out, the second is made $\frac{1}{4}$ in. off the center line, the third $\frac{1}{2}$ in. off the line, and the fourth $\frac{3}{4}$ in. off the line. With this arrangement there are always at least two grooves open to the perforations so that the lubricant can reach the inside of the bronze bushing regardless of the position of the bushing when the grease plugs are screwed down. No change was made from the original method of preparing the perforated bronze bushing.

In preparing the steel bushing it is ground to a perfectly smooth surface inside. In the absence of a grinder for the purpose, this is done before the bushing is re-



moved from the lathe by using a shop-made holder and spindle for a small grinding wheel, this holder being bolted to the carriage of the lathe after removing the tool post and driven by a small pneumatic tell-tale motor. Running the grinder through the bushing two or three times as the lathe is revolving slowly and using the carriage for feeding, the grinder makes an excellent job which takes only a few minutes. After cutting the cross grooves, the bushing is pressed into the rod at about 25 tons pressure, care being taken to place the bushing in such position as not to have the direct point of thrust in line with the groove.

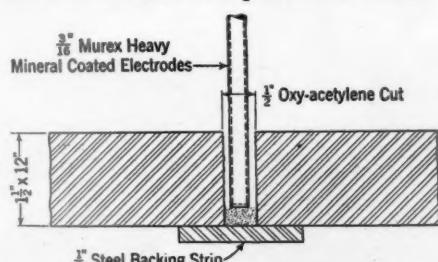
The bronze bushing is bored to as close a working fit as is possible on the crank pin. The outside is turned to $\frac{1}{64}$ in. smaller than the bore of the steel bushing and only $\frac{1}{32}$ in. lateral play allowed instead of the recommended $\frac{3}{32}$ in. for expansion. The bushing is applied solid and not split in any manner as is practiced by some railroads to take care of expansion, although this split might be of some benefit as a means of getting the grease to the inside of the bushing.

Other methods than that as shown here are in use and are evidently serving the purpose satisfactorily. It is not the intention of the writer to criticize or condemn, but I feel that this simple method might appeal to those who are having, or have had, trouble with floating bushings and might prove of interest to others, as it has "turned the trick" in this particular case, with the result that at 55,000 miles the side-rod bushings, on first inspection, were found to be worn less than $\frac{1}{32}$ in. and the main-rod bushings less than $\frac{3}{64}$ in. and the life of the bushings increased from about 10,000 miles to more than 100,000 miles, or over 1,000 per cent. The point the writer wishes to stress is that, after getting a good grade of bronze, proper lubrication, regardless of the method of preparation used, is the prime factor in the life of the bushings.

Straight Gap Welding

THE Metal & Thermit Corporation, New York, has, in a measure, gone into competition with itself by introducing an electric welding process known as Murex straight gap welding. It does away with the need for "veeing" or grooving of plate edges.

Heretofore it has been the practice to bevel the edges



Arrangement of plates and backing strip for straight gap welding of a 12-in. seam in a 1½-in. plate

of plates to be welded and the narrowest bevel considered possible was 12 deg. on each plate, making a total included angle of 24 deg. When the bevel angle is made smaller than this, the metal which is filled in undercuts the sides of the plates and causes pockets to be formed from which slag cannot be removed.

With the straight gap method, square-edged plates are

lined up with the welding edges parallel and with a steel backed strip $\frac{1}{8}$ in. thick or heavier to close the bottom of the gap. The space between the plates varies according to the size of the electrodes used.

The welding wire has a heavy mineral coating which effectively keeps oxygen and nitrogen out of the weld. The deposited metal passes through the arc in a fine spray without spattering and without abrupt momentary changes in the current flow. It is deposited in the gap with a fillet at either edge and without the formation of pockets in the plate edges. The slag is extremely brittle and is easy to remove.

With this process, a relatively small amount of metal is required to fill the joint. It is suitable for plates up to 4 in. in thickness. Smooth even deposits of unusual high tensile strength and ductility are obtained consistently.

Difficult Pipe Bends Made With Special Table

IN the fabrication of the preheater and superheater coils for the steam-heat boilers of Pennsylvania electric locomotives a rather difficult job of pipe bending is involved not only because of the necessity of accuracy in bending, but also because of the short radii of some of the bends. The coils, as shown in Fig. 1, consist of two reversed coils of 1½-in. and 2-in. extra

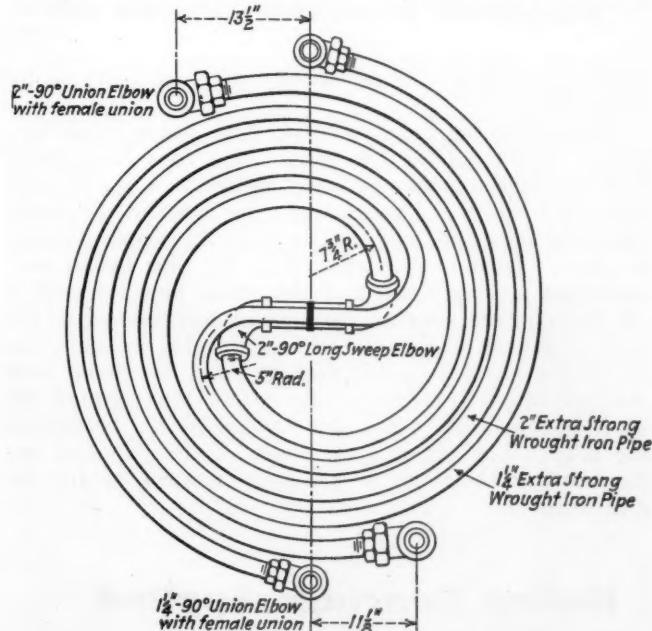


Fig. 1—The preheater and superheater tube are in the form of a reverse bend

strong wrought iron pipe, having minimum bends of 5 in. and $3\frac{1}{4}$ in. radii, respectively. When instructions were given the Juniata shop at Altoona, Pa., to make up a number of sets of these coils, the pipe department at that shop developed a bending table that made it possible, with a proper heating practice, to produce coils as symmetrical and even as though they had been formed in a special forming or rolling device.

Fig. 2 shows the important details of the bending table and the advantages of this device over the common table or bench vise are apparent. A large part of the actual saving in the cost of production as compared with the bench vise method resulted from the elimination of

the necessity for the workmen continually to check the contour of the pipe with templates as the bending proceeded.

The table is so laid out that the positions of the pins give the correct contour of coils which results in a

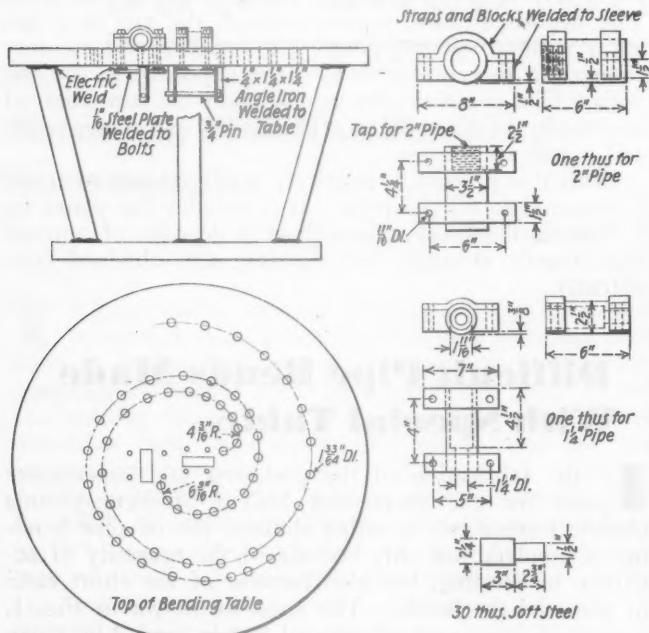


Fig. 2—Details of the special pipe-bending table

further saving in the assembling of these coils to the boiler lids.

When forming 2-in. coils the 2-in. sleeve is set in a recess on the top of the table. The four 5-in. clamp bolts are held together by being welded to a $\frac{1}{16}$ -in. steel plate and are raised up through the holes in the sleeve clamping lugs and tightened to hold the sleeve securely in place. Heat is then applied to the pipe by an oxy-acetylene heating torch and the guide pins inserted in the holes in the table as the heating and bending of the coil progresses. When forming the $1\frac{1}{4}$ -in. coils the sleeve for the 2-in. coil is removed and the clamp bolts are permitted to drop on the safety pin through the safety angle irons which are welded to the bottom of the table. The $1\frac{1}{4}$ -in. pipe sleeve is then applied and the bending continued in the same manner as for the 2-in. coils.

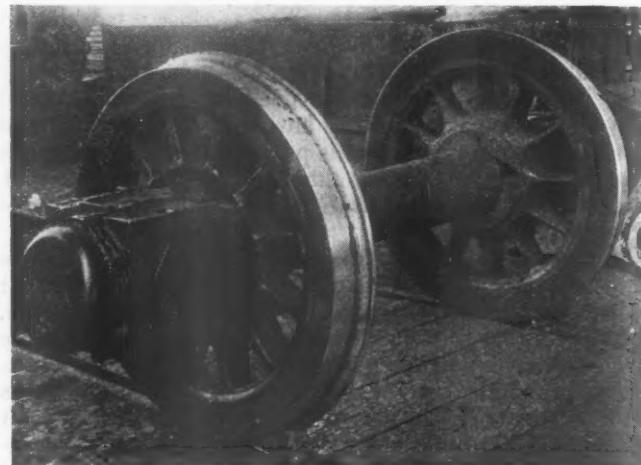
Roller Bearings Applied To Trailer Trucks

IWING to increased train speeds and severe operating conditions, a midwestern road recently experienced considerable trouble with hot trailer journals on a group of 4-8-4 type locomotives. This trouble was apparently accentuated by a ruling which reduced permissible lateral play on No. 1 locomotive trailer wheels to one in. The decision was made to remedy the trouble by the application of Timken roller bearings and this work was done at the railroad's principal back shop. Inasmuch as the shop was not equipped with special machinery and tools required for the most convenient handling of the conversion work ingenuity was required on the part of the shop supervisors to develop a method of machining and assembly that would produce the required accuracy.

A representative of the roller-bearing manufacturer was present and passed on all details of the work, inspecting not only the various units of the roller bearings, as received from the factory, but also checking with the greatest care all details of the railroad shop machining and assembly operations.

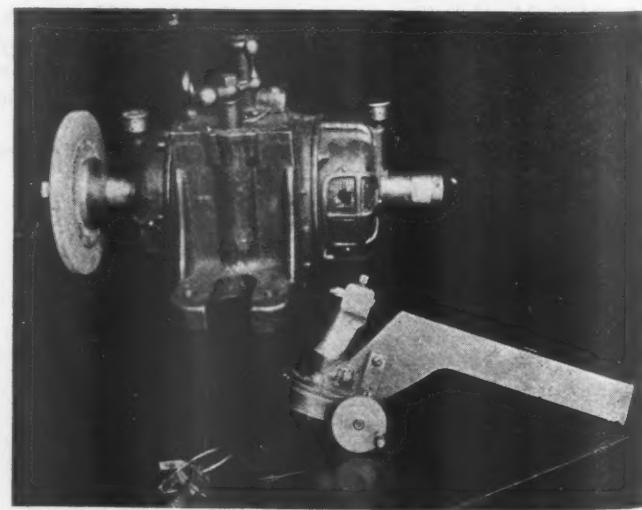
Fitting the Races

To accommodate and fit the roller-bearing races, the trailer journals were turned down in a large engine lathe, allowing from .008 in. to .012 in. for grinding, which, in



Timken roller bearings applied to a pair of trailer-wheel journals in the shop

the absence of a grinding machine of the required capacity was done in the same lathe, using the small portable tool-post grinder, illustrated. Several wheel grains and grades, as well as widths of wheel face, were tried before the best combination was secured. The grinding was done dry, in three or four cuts, a tolerance of only .002 in. in diameter being permitted and .0005 in. in taper. To obtain this degree of accuracy with the equipment available required considerable ex-



Tool-post grinder, radius-turning tool and gages used in machining trailer journals for the application of roller bearings

perimentation and adjustment of procedure. The temperature of the journals, for example, was a factor which had to be taken into consideration, since newly-ground and still warm journals, caliperized at the close of the

day's work, were larger than in the morning after having had time to cool.

The attempt was first made to machine fillets with a forming tool ground to the required radius, but this method proved unsatisfactory, owing to the practical impossibility of eliminating vibration and securing a smooth surface finish on the fillet. A successful effort to solve this difficulty was devised by means of the radius-turning tool, illustrated. This tool consists of a small rotating tool post and bit, suitably supported in the base of the tool, which has an offset, forged-steel shank of the proper proportions to insert in the lathe tool post. The rotating tool post is manually-operated by means of the small handwheel, illustrated, which turns a bronze worm and gear, housed in the base of the tool. The cutting tool bit, held in the upper part of the revolving head, is capable of adjustment in or out by means of a set screw. This tool bit is set to give the required radius by means of stamped gages. By rigidly clamping this radius-turning tool in the tool post of the lathe and using a properly-ground tool bit, set to the required radius, a smooth, accurate fillet can be cut to any radius ordinarily needed. After being turned, the fillets are polished with a stick, using oil and an emery cloth.

After pressing on the raceways and assembling the complete bearings the journal bearing and housing present the appearance shown in one of the illustrations. Cap bolts, which hold the outside casing in an oil-tight bearing against the journal box, are drilled through the heads and connected in pairs with copper wire to make absolutely sure that they cannot back out accidentally under vibration.

The Timken roller-bearing-equipped trailer wheels, as installed in the truck under one of the 4-8-4 type locomotives, are also shown in another illustration. Since the application of these roller bearings trouble with hot trailer journals has been eliminated and it is said that the savings in oil alone, not to mention the labor of inspecting and repacking journal boxes, will go a long way towards paying for the new roller bearings.

Vital Importance of Adequate Valve Lubrication

By Walter Smith

FROM the viewpoint of effective valve and valve-gear performance, adequate lubrication of piston valves is a factor of paramount importance. It has been proved definitely that where valves and cylinders are not lubricated properly, a locomotive will lose at least 15 per cent of its efficiency. Furthermore, tests have shown conclusively that the effect of insufficient lubrication results in a loss of power of from 12 to 15 per cent. The effects of improperly lubricated valves are as follows:

(1) Valves require greater driving power, which absorbs engine power at the expense of drawbar pull. Besides, when valve lubrication is defective, cylinder lubrication usually is affected adversely, which still further dissipates power.

(2) The drag on the valve gear is greatly increased, which magnifies the effect of lost motion, and may cause the parts to spring or yield, with the result that the valve events become distorted. The usual effects of distorted valve gears on steam control are irregular time and variable volume.

(3) There is rapid wear of the valve rings and bushings with a resultant increase in valve leakage.

(4) There is the possibility that valve and valve gear failures may result from the overload on valve-gear parts.

With the tendency in modern locomotive design toward increased boiler pressure and higher superheat, the problem of obtaining proper lubrication of valves and cylinders becomes vitally important. Because of the inherent characteristics of piston valves, which function by virtue of the properties of sliding metallic surfaces, the matter of obtaining adequate lubrication under present conditions is an exceedingly difficult problem.



Trailer wheels with Timken-equipped journals installed under a locomotive ready for service

Regarding the theory of lubrication, it is well to bear in mind that the sliding friction of metal in contact is increased by heat, and diminished by polishing and by efficient lubrication, and is less in motion than in starting. It is generally conceded that effective lubrication is a matter of maintaining a protective oil film between the metallic surfaces, so that the sliding friction is reduced. In order that the oil film may be maintained, it is important that there be continuous distribution. This requires a positive oil feed, and an oil supply proportionate to the work.

As can readily be appreciated from the foregoing, an oil to preserve the protective oil film, under present service conditions, must have extraordinary properties. It must have tenacity and body to a marked degree; it must emulsify and atomize; and it must have sufficient power of vaporization to spread itself over the steam—that is, to lubricate the steam. That oil can have sufficient strength, tenacity, and body at high temperature to preserve the protective film, and prevent opposing metals coming in direct contact, is difficult to conceive. Then it must be assumed that occasionally the oil film is destroyed on account of a bad water condition in the boiler or because the oil is carbonized when the throttle is closed.

The problem of how to restore quickly this lubricating film is difficult of solution, for the reason that a surplus of oil is required, and the regular feed supplies only the amount of oil necessary to replace the wear of the film. Under favorable conditions the life of this oil film is dependent upon (1) the pressure of the packing rings tending to expand them; (2) the temperature of the valve chamber; (3) the number of times rubbed over; (4) the polish on the metallic surfaces; and (5) the properties of the oil.

While condensation, or hydrostatic lubricators are entitled to a maximum of credit for the splendid service rendered in the past, they are entirely inadequate for present conditions. The modern locomotive necessitated a more or less revolutionary change in the method of lubrication, and it has been found that the mechanical lubricator has a distinct advantage in that it provides more efficient feeding of the oil to the valves and cylinders. Present service conditions require positive and not intermittent feeding, with oil delivered in proportion to the work done, which is determined by speed and cut-off. When force-feed lubricators are arranged to inject oil in proportion to the piston speed and cut-off, it is possible to obtain a surplus of oil to meet unusual demands by lengthening the cut-off. In order to maintain regularity of feed with the force-feed lubricator, the heat of the oil in the lubricator must be controlled, so as to prevent wide variations in oil temperature and viscosity. Thermostatic heat control probably offers the best solution of this problem. Cylinder feeds are not only desirable but absolutely necessary on modern high-pressure power. They not only insure better cylinder lubrication, but have a beneficial effect on valve lubrication, because the oil in the exhaust steam tends to improve the lubrication of the exhaust rings.

Factors Adversely Affecting Lubrication

Regardless of the effectiveness of the force-feed lubrication system from the standpoint of continuous oil delivery, and in spite of the quality of the oil supplied, there are disturbing factors which make proper lubrication difficult of accomplishment. The principal factors in connection with locomotive operation which adversely affect valve and cylinder lubrication are (1) boiler feed-water troubles; (2) carbonization of oil; and (3) valve leakage. The latter is aggravated by the foregoing

factors, and by the poor valve maintenance practices already described.

Boiler Feed-Water Troubles

No question pertaining to the operation of locomotives deserves more consideration than the matter of generating clean, dry steam. When steam carrying entrained water, also sludge and sediment, is delivered to the superheater, a decided loss in efficiency results. On account of the moisture in the steam, the superheater must not only function as a superheater, but as an evaporator as well, with the result that the degree of superheat is reduced. Then during the drying out process a gritty substance is released, which is carried into the valve chambers and cylinders. This sediment combines with the oil on the bearing surfaces and forms an abrasive mixture, which destroys lubrication and causes rapid wear of the valve and cylinder packing.

There is still a chance for great improvement over present feed-water practice as it exists throughout the country. Unfortunately, there are only a few places where pure feed water for locomotive use is available, and the cost of treated water is prohibitive in some cases. If the water has much of any solids or alkali salts in solution, there is a tendency for the boiler to foam. When a boiler foams, the entire steam space is filled with a froth or foam, resulting in its withdrawal with the steam. As the impurities in the feed water are accumulated and concentrated in the foam, the effect on lubrication is apparent.

While the principal cause for the production of poor quality steam is impure feed water, there are features in the design and arrangement of the boiler which have a tendency to aggravate the trouble. Steam carrying entrained water will be delivered to the superheater (a) if the design of the boiler is such that the steam space is restricted; (b) if the steam dome is located too near the crown sheet or combustion chamber; (c) if baffle plates are not placed under the safety valves to prevent a direct flow of steam when open; and (d) if the circulation in the boiler is too violent. Furthermore these defects are augmented (1) by high rates of evaporation, (2) by the present practice of running continuously with a wide open throttle, and (3) by the practice of carrying a high water level in the boiler. It is not uncommon for steam to carry 5 per cent or more of moisture when it enters the superheater units and there are extreme cases where the superheater must handle steam carrying entrained water amounting to as much as 15 per cent.

Ever since the introduction of the superheater the problem of preventing carbonization of the oil in the valve chambers, cylinders and passages has been vitally important. Carbonization of oil destroys lubrication, for the reason that oil when carbonized changes from a lubricant to an adhering abrasive. The gummy substance thus formed not only causes increased friction and consequently greater wear of the sliding surfaces, but it clogs the ports and passages. This building up of carbon deposits, in and around the valve ports, disturbs steam distribution, increases back pressure, and adversely affects fuel consumption.

Regarding the carbonization of oil, it is well known that a temperature as high or higher than the flash point of the oil is required and that air must be present to support combustion; also that the oil does not flash or burn in an atmosphere of steam, even though the temperature is 1000 deg. F. Therefore, in order to prevent carbonization, air must be excluded from the valve chambers and cylinders, either (1) by maintaining an atmosphere of steam at all times or (2) by preventing the formation of a vacuum, which would draw in air.

Among the Clubs and Associations

THE AIR BRAKE ASSOCIATION has moved its headquarters from the Grand Central Terminal building to Room 2205, 150 Broadway, New York.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—A meeting of the General Foremen's Association will be held on June 17 at Chicago for the purpose of electing officers, revising the constitution, and conducting such other business as may come before the association.

FUEL ASSOCIATION.—A regular meeting of the members of the International Railway Fuel Association for the purpose of electing officers, amending the constitution and by-laws, and transacting such other business as is necessary, will be held at the Hotel Sherman, Chicago, on Friday morning, June 16, at 10:30 Central Daylight Saving Time. Work on the preparation of committee reports has been aggressively carried on in spite of the temporary discontinuance of technical meetings of the association, and it is expected that reports for the year 1933 will be available in the form of published proceedings by next October.

PURCHASES AND STORES DIVISION.—The annual convention of Purchases and Stores Division, A. R. A., will be confined to a meeting of the general committee and chairmen of subject committees at the Stevens Hotel, Chicago, Monday, June 26, according to the announcement of Secretary W. J. Farrell. Plans for the convention have been abandoned in view of economic conditions. A. G. Follette, general material supervisor of the Pennsylvania and C. M. Woodward, in the purchasing department of the Pennsylvania, have been announced as winners in the annual contest held by this Division for papers on Railway Purchasing and Stores Work. It is expected that these papers, entitled "Energizing the Supply Dollar" and "Direct Results from Indirect Purchases", respectively, will be presented at June meeting.

WESTERN RAILWAY CLUB.—Meeting and dinner at the Hotel Sherman, Chicago, on Monday evening, May 15. Address delivered by H. A. Wheeler, president, Railway Business Association, who presented the subject "Regulation of Transportation in Light of 1933 Developments." ¶ Mr. Wheeler was introduced by Samuel O. Dunn, editor, Railway Age, and chairman of the board, Simmons-Boardman Publishing Company. ¶ At the business session, presided over by Retiring President O. E. Ward, superintendent of motive power, Chicago, Burlington & Quincy, Lines East, the following officers were elected for the ensuing year: President, J. E. Bjorkholm, assistant superintendent of motive power, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; first vice-president, A. N. Williams, president and general manager, Chicago & Western Indiana, Chicago; second vice-president, Lee

Robinson, assistant to general superintendent of motive power, Illinois Central, Chicago; secretary, C. L. Emerson, division master mechanic, Chicago, Milwaukee, St. Paul & Pacific, Chicago; and treasurer, J. W. Fogg, MacLean-Fogg Lock Nut Company, Chicago. Board of Directors: W. A. Bender, master car builder, Alton, Bloomington, Ill.; J. E. Bunker, vice-president, Vapor Car Heating Company, Chicago; J. T. Gillick, vice-president, Chicago, Milwaukee, St. Paul & Pacific, Chicago; F. W. Rosser, general manager, Erie, Youngstown, Ohio; D. C. Curtis, chief purchasing officer, Chicago, Milwaukee, St. Paul & Pacific, Chicago; J. H. Nash, Dri-Steam Valve Company, Chicago; H. P. Allstrand, principal assistant superintendent motive power and machinery, Chicago & North Western, Chicago; C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe, Chicago; G. F. Slaughter, American Steel Foundries, Chicago; J. C. Shreeve, superintendent of motive power, Elgin, Joliet & Eastern, Joliet, Ill.; P. J. Colligan, general superintendent of motive power, Chicago, Rock Island & Pacific, Chicago; O. E. Ward, superintendent of motive power, Chicago, Burlington, & Quincy, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the spring meeting of the A. S. M. E., which will be held at Chicago during Engineers Week at the Century of Progress during the last week in June, the Railroad Division will hold morning and afternoon sessions on Monday, June 26. Both sessions will be devoted to the contributions of research in the development of railway equipment. The morning session, over which L. A. Downs, president of the Illinois Central, will preside, will be opened with an address by R. H. Aishton, chairman of the American Railway Association, after which the following papers will be presented:

Research Done by Railroads, by Col. C. D. Young, vice-president, Pennsylvania

Research Done by Industries, by Samuel O. Dunn, chairman of board, Simmons-Boardman Publishing Company

Research Done by Universities, by Prof. G. A. Young, Purdue University, and Prof. E. C. Schmidt, University of Illinois

The afternoon session will be devoted to discussions of specific phases of research developments as set forth by the papers at the morning session. The discussions will be as follows:

Research and Development Resulting in the Promotion of the Standard Freight Car, by F. H. Hardin, assistant to president, New York Central Lines

Car Trucks and the Development of Steel Castings, by Harry M. Pflager, senior vice-president, General Steel Castings Corporation

Locomotive and Car Wheels, by Charles Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe

Development of Passenger Cars, by Peter Parke, chief engineer, The Pullman Company

Automotive Engines and Cars, by L. G. Coleman, manager, Locomotive Department, Ingersoll-Rand Company

Car and Locomotive Air Brakes, by Samuel Dudley, professor of mechanical engineering, Yale University

Development of Draft Gear, by L. P. Michael, chief mechanical engineer, Chicago & North Western

Locomotive Development, by W. E. Woodard, vice-president, Lima Locomotive Works, Inc.

Development of the Locomotive Boiler, by H. B. Oatley, vice-president, the Superheater Co.

Running Gear and Counterbalancing, by A. G. Trumbull, chief mechanical engineer, Advisory Mechanical Committee, Chesapeake & Ohio; Pere Marquette; Erie, and New York, Chicago & St. Louis

Locomotive Valve Gears and Steam Distribution, by G. S. Edmonds, superintendent motive power, Delaware & Hudson

Research and Development of Locomotive Accessories, by C. H. Bily, mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific

Car and Locomotive Materials, by Lawford Fry, railway engineer, Edgewater Steel Company.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V. MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

Division V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

Division VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

Division I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. 39th St., N. Y. C.

RAILROAD DIVISION.—Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Washington street, Winona, Minn.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stigemeier, secretary, 29 Parkwood street, Albany, N. Y.

NEWS

Austro-Daimler Rail Car

A 42-PASSENGER RAIL CAR, weighing 20,000 lb., has arrived in this country from Vienna, Austria, and is now being demonstrated on the Long Island Railroad. The car, a product of Austro-Daimler of Vienna, employs a new system of air suspension, pneumatic tires being used in conjunction with ordinary railroad tires. It is equipped with two gasoline motors of 80 hp. each, and the fuel consumption is 7 miles per gallon. It is 38 ft. 6 in. long, 7 ft. 8 in. wide, and 8 ft. in. high. E. K. Howe & Sons, Inc., 500 Fifth avenue, New York, have the exclusive license to manufacture and sell these rail cars in the United States.

Union Pacific Orders High-Speed Streamlined Train

AN ORDER has been placed by the Union Pacific for a distillate-electric articulated passenger train comprising three body units of light weight, fully streamlined construction, capable of speeds up to 110 m.p.h. The train will be built by the Pullman Car & Manufacturing Corporation and powered with a 600-hp., 12-cylinder V-type distillate-

a sustained speed on straight and level track of 90 m.p.h., and will weigh not over 80 tons. A streamlined car-body design, to be decided on as the result of wind-tunnel tests, will be adopted to give minimum air resistance, and to get the benefits of full streamlining the windows of shatter-proof glass will be flush with the outside of the car, the vestibules will be covered, and exterior accessories recessed into the car body. The train will be fully air-conditioned with sealed windows, forced ventilation being used to supply heat in winter and to cool the train in summer. Sealed windows, body insulation, streamlining, the use of rubber in the trucks and the probable use of a resilient wheel will materially reduce noise. The train will be completely equipped with roller bearings. The lighting system will be indirect, giving a uniform light reflected from the ceiling.

The train will consist of three cars supported on four trucks. The first car body will contain the power plant, consisting of engine and generator, and the driving trucks on which the motors are mounted will be on the forward end of this. Included also in the first forward car will be a 30-ft. railway post office compartment.

This train will not have any sleeping accommodations.

The research and development work leading to the design of this train has been conducted by E. E. Adams, vice-president engineering, of the Union Pacific, with assistance and suggestions from many individuals and companies, of which the following submitted definite proposals: The Pullman Company, in collaboration with the Winton Engine Corporation, and with William B. Stout, aeronautical engineer; the Brill Company, with the McIntosh-Seymour Engine Company; the Edward G. Budd Company, with the Winton Engine Corporation, and the Ingersoll-Rand Company, with the St. Louis Car Company.

Howard L. Ingersoll Honored by Franklin Institute

AMONG THE FOURTEEN recipients of honors for outstanding accomplishments in the arts and sciences who received medals at the Meday Day exercises of the Franklin Institute of the State of Pennsylvania, held in the hall of the Institute, Philadelphia, Pa., on May 17, was Howard L. Ingersoll, assistant to the president, New York Central Lines, who was awarded the Edward Longstreth medal in recognition of his work in the "development of the Locomotive Booster to a state in which it gives valuable aid to locomotive performance and railroad service."

For some years it had been recognized that it was desirable under certain operating conditions to be able to supplement the primary power of a steam locomotive for short periods at starting and at low speeds and many efforts were made to accomplish this by devices which acted as traction increasers by bringing additional power wheels into play, or by the application of an independent driving mechanism to the locomotive tender. All of these experiments proved impracticable in operation and it remained for Mr. Ingersoll to visualize and develop the first successful solution of this problem in what is now known as the Locomotive Booster. In approaching the problem of the development of a Booster the inventor observed that

(1) Inasmuch as the tractive force furnished by the Locomotive Booster was to be used only at starting, accelerating and at slow speeds, the mechanism of the Booster should be normally inoperative.

(2) The Locomotive Booster must not interfere or change the normal functioning of the locomotive itself.

(3) The Locomotive Booster must be so controlled as to impose no burdensome duties on the engineman.

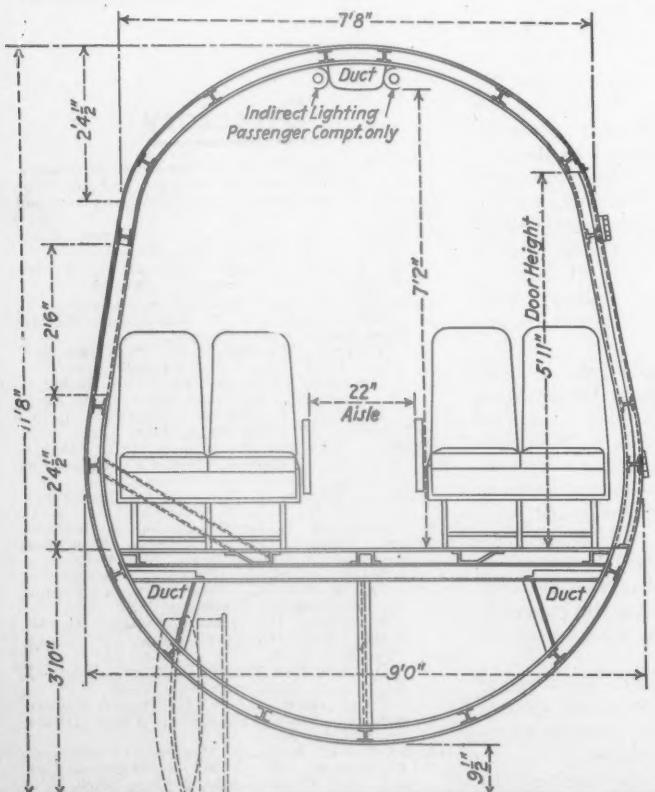
(4) The control of the Locomotive Booster must be provided with the following safeguards:

(a) The power of the Booster must be interlocked with the control mechanism of the locomotive.

(b) The Booster must automatically disengage or become inoperative when the locomotive reaches a stage where the power of the Booster is no longer required.

(c) The Booster must be so arranged that the engineman may, as his judgment indicates, connect or disconnect the Booster as the occasion demands within its working range.

The original Locomotive Booster as in-



Proposed body cross-section of the Union Pacific articulated train

burning internal-combustion engine, to be manufactured by the Winton Engine Corporation. The equipment is designed for a maximum speed of 110 m.p.h., with

and baggage room. The second car will be a coach seating 60 passengers and the rear car a 56-passenger coach, with a buffet at the rear end to serve light meals.

Supply Trade Notes

vented by Mr. Ingersoll was a horizontal two-cylinder, double-acting engine, non-reversing, mounted on the trailer truck and geared to the trailer axle through an idler gear which could be put into or out of operative engagement. Steam coming directly from the boiler was admitted at three-quarters stroke with no variation of the cut-off in the Booster cylinders, although the steam admission was under the control of the engineman. The Booster had a flexible mounting in the form of a three-point suspension, two bearings being on the trailer axle and one in a spherical seat in the frame of the trailer truck, permitting the Booster to swing as the trailer swings. The First Booster designed by and built under the direction of Mr. Ingersoll was put into service on a New York Central Atlantic type locomotive No. 990 early in 1919. Shortly thereafter, other applications having been made to demonstrate the practicability of the device, the further development and promotion of the Booster was carried on by the Franklin Railway Supply Company, New York.

The Booster as it is used today on 88 railroads in the United States and on the railroads of several foreign countries remains in principle as it was originally designed by Mr. Ingersoll.

H. H. Moss Honored

AT THE annual meeting of the American Welding Society, held at the Hotel Governor Clinton in New York on April 27 and 28, the Samuel Wylie Miller medal was awarded to H. H. Moss of New York "for his achievement in the application of fusion welding and oxyacetylene flame cutting." The Samuel Wylie Miller medal, an annual award of the American Welding Society, is presented for meritorious contributions to the science and art of welding. It was established in 1927 by the late Samuel Wylie Miller.

Mr. Moss, an engineer in the service of The Linde Air Products Company, has been engaged in a variety of problems on the use of oxyacetylene welding and cutting in structural work, oil and natural gas transmission projects, and transportation equipment, particularly freight cars and shipping containers.

In 1931 his aid to the Committee on Technological Developments under President Hoover's Conference on Home Building and Home Ownership in connection with the use of welding in present and future small house construction, culminated in a presentation of the subject before the Conference. More recently Mr. Moss has been giving careful study to advanced developments in oxyacetylene cutting, particularly in the field of flame machining, in which process an oxyacetylene flame is used for cutting, boring and shaping metal parts in a way similar to the machine-tool operations used for fabricating metal parts up to this time. The preliminary results of the investigation in flame machining were presented in a paper read before the American Welding Society at its 1932 Fall convention in Buffalo.

Mr. Moss has been active in the affairs of the American Welding Society, American Bureau of Welding and the International Acetylene Association. He is also a member of the A. S. of M. E.

THE WHITING CORPORATION, Harvey, Ill., has moved its Chicago office to 140 South Dearborn street.

C. E. GRAHAM, handling general railway supplies, has moved his office from 370 Lexington avenue, to 61 Hudson street, New York City.

CYRUS J. HOLLAND, Peoples Gas building, Chicago, has been appointed western representative of the Standard Locomotive Equipment Company, Toledo, Ohio.

THE EARLE GEAR & MACHINE COMPANY, Philadelphia, Pa., has moved its New York City sales office from 95 Liberty street to 149 Broadway, New York.

THE CHICAGO SALES OFFICE of the universal pipe division of the Central Foundry Company, New York, is now located at 1629 Wellington street, Chicago.

THE EDGEWATER STEEL COMPANY, Pittsburgh, Pa., has appointed H. F. Lowman, 912 Investment building, Washington, D. C., its representative in that territory.

FREDERIC B. PLATT has been appointed eastern representative of the T-Z Railway Equipment Company and Morris B. Brewster Company, Inc., of Chicago. Mr. Platt's headquarters are at Boston, Mass.

THE WORTHINGTON PUMP & MACHINERY CORPORATION has moved its general and executive offices from 2 Park avenue, New York, to its new office building adjacent to the corporation's plant at Harrison, N. J., which was opened on May 1. The local sales office will be continued at 2 Park avenue, New York.

C. A. SATTLEY has been appointed representative of The Winton Engine Corporation, Cleveland, Ohio. Mr. Sattley is in charge of the Chicago territory, with office at 319 Peoples Gas building, Chicago. He succeeds J. F. Sattley, deceased, who previously represented The Electro-Motive Company and the Winton Engine Corporation in that territory.

DAVID K. E. BRUCE, Paul D. Cravath, and Marshall Field, have been re-elected directors of the Westinghouse Electric & Manufacturing Company. C. A. Terry, honorary vice-president, has been elected a director for a four-year term and Warren H. Jones, secretary, has been elected to complete the term made vacant by the death of E. M. Herr, late vice-chairman.

OTHO C. DURYEA of the O. C. Duryea Corporation, New York, was the recipient of the George R. Henderson medal awarded at the recent Medal Day exercises of the Franklin Institute of the State of Pennsylvania "in consideration of the meritorious railway engineering and the novel feature embodied in the invention of the Duryea railway car cushioned under-frame."

THE REPUBLIC STEEL CORPORATION, Youngstown, Ohio, has moved its Buffalo, N. Y., district sales office to 475 Abbott Road. Thomas B. Davies, district sales manager, and his present staff will continue in charge at the new location.

L. D. DODSON has been placed in charge of the New York office of the J. B. Ford Sales Company. Mr. Dodson had for several years been in the main office at Wyandotte, Mich., where R. D. Sherwood is now manager. G. T. Robinson, assistant manager, succeeds Mr. Sherwood as manager at Cleveland, Ohio, and Mr. Gline, formerly New York manager, has been de-ailed to special work on national accounts, with headquarters at New York.

THE WINE RAILWAY APPLIANCE COMPANY, Toledo, Ohio, has rearranged its territories. George B. Christian is now sales engineer for the western territory, with headquarters at Toledo, Ohio. This territory was formerly in charge of Cyrus J. Holland. The southeastern territory has been divided between Earl H. Fisher, of Toledo, and Cyrus Hankins, of Washington, D. C.

ARTHUR S. GOBLE has become associated with the Hanna Stoker Company as vice-president, with duties including jurisdiction over the sales department. Mr. Goble's headquarters will be at Cincinnati,



Arthur S. Goble

Ohio. In 1904 he completed a course in chemical engineering at the University of Illinois and the same year entered the service of the Chicago & North Western as assistant to the chemist and engineer of tests. He left that road in 1911 to enter the sales departments of the Baldwin Locomotive Works and the Standard Steel Works Company, in the New York office and later served in the Chicago office. The last 14 years of his service with these companies he was district manager at St. Louis, Mo., in charge of sales matters in the southwestern section of the United States. Mr. Goble left that service in August, 1932, after a period of 22 years with these companies.

HERBERT K. WILLIAMS has been appointed assistant to president of the Safety Car Heating & Lighting Company, with office at New York. Mr. Williams was born in Orange, N. J., in 1888. Immediately following his graduation from the Orange High School in 1905, he entered the employ of the Safety Car Heating & Lighting Company as a clerk in the office of the mechanical engineer. After six years of service in the engineering and executive departments of the company and



Herbert K. Williams

at the time the axle lighting system for railway passenger equipment cars was just coming into prominence, Mr. Williams was transferred to the factory where he spent a large part of his time in the laboratory in a general study of the theory and design of axle lighting equipment. In 1916 he was assigned to the New York sales district as representative. In 1918 the export business of the company was consolidated in a department over which Mr. Williams was placed in charge, although at the same time he continued his connection with the New York sales district. In 1926 Mr. Williams was appointed sales engineer. In 1928 he was made manager of the equipment department in charge of sales, which position he held up to the time of his present appointment.

THE SAFETY CAR HEATING & LIGHTING COMPANY has moved its Chicago district office from 1134 Straus building to 1455 Railway Exchange building, 80 East Jackson Boulevard. George H. Scott, manager, remains in charge.

THE CANTON TANK CAR COMPANY, Chicago, has moved its general offices from 310 South Michigan avenue, Chicago, to 621 Perry Payne building, Cleveland, Ohio. H. S. Woodruff, vice-president, has resigned to engage in other business and the office of vice-president has been abolished.

THE WOOD PRESERVING CORPORATION, Koppers building, Pittsburgh, Pa., has established an operating unit, which will be supervised by Reamy Joyce and Sherman S. Watkins, formerly of the Joyce-Watkins Company, Chicago. The activities of Messrs. Joyce and Watkins will be principally in connection with the Baltimore & Ohio cross tie production and in the operation of the Green Spring, West Va., treating plant.

FRANK A. HITER, sales manager of the Alemite Corporation, Chicago, a subsidiary of the Stewart-Warner Corporation, has been appointed sales manager of the parent company and subsidiaries, to succeed W. J. Zucker, vice-president, general sales manager and secretary, resigned.

THE WORRINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., and the Gamon Meter Company have consolidated their operations in the manufacture and sale of meters, through the newly organized Worthington-Gamon Meter Company, with sales headquarters at Harrison; all manufacturing operations, however, will be concentrated in the Gamon plant at Newark. The officers are as follows: E. T. Fishwick, president; G. H. Gleeson, vice-president in charge of sales; J. A. Bonnet, secretary; R. R. Anderson, works manager.

THE GALE SERVICE & CONSTRUCTION COMPANY has been organized with offices in the Railway Exchange building, Chicago, to engage in the construction and repair of boiler washing facilities, water softening systems, water supply systems and brick, concrete and frame buildings. All of the employees, officers and stockholders of the company were employees of the National Boiler Washing Company of Illinois. The officers are: Frederick A. Gale, president; Walter C. Thatcher, vice-president and chief engineer; and M. S. Bachman, secretary and treasurer.

F. W. MAGIN, formerly executive vice-president in charge of the industrial controller division at Milwaukee, Wis., was elected president of the Square D Company, with headquarters at Detroit, Mich., at a meeting of the board of directors held recently. T. J. Kauffman was elected chairman of the board. H. S. Morgan was elected secretary-treasurer. Mr. Morgan was formerly a member of the board of directors and retains his position on the board. J. H. Pengilly of Los Angeles, L. W. Mercer, Vernon Brown and Carlton M. Higbie were elected vice-presidents.

THE PRESSED STEEL CAR COMPANY having been handicapped in its efforts to refund its 10-year 5 per cent convertible gold debentures due January 1, 1933, by suits of individual bondholders, although the indentures securing these debentures provides that action can only be taken by 25 per cent of the holders through the trustee, to avoid giving a preference to these bondholders, acquiesced to the appointment at Pittsburgh, Pa., on May 11, 1933, of George D. Wick and Frank N. Hoffstot, president of the company, as receivers, by Judge R. M. Gibson of the United States District Court. The company has no other creditors.

THE FRANKLIN RAILWAY OIL CORPORATION whose main office formerly was at Franklin, Pa., has established two territories in the United States—an eastern district with headquarters at 26 Broadway, New York City, and a western district with headquarters at 59 East Van Buren street, Chicago. R. R. Vinnedge, vice-president, is in charge of the eastern office

and John E. Ferry, vice-president, is in charge of the western office. The works are at Franklin, Pa. As in the past the Franklin Railway Oil Corporation will continue to handle sales of lubricating oils and greases to steam railroads for the Socony-Vacuum Corporation, which comprises the following companies: Standard Oil Company of New York, Inc., New York, Vacuum Oil Company, Inc., New York, Magnolia Petroleum Corporation, Dallas, Texas, White Eagle Oil Corporation, Kansas City, Mo., General Petroleum Corporation, Los Angeles, Cal., White Star Refining Co., Detroit, Mich., Wadham's Oil Co., Milwaukee, and Lubrite Refining Co., St. Louis.

THE UNITED STATES STEEL CORPORATION has made following additions to the staff of the commercial office headed by C. L. Wood, commercial vice-president; F. D. Foote, assistant to vice-president, in which position he will be responsible for the coordination of sales efforts affecting the railroads and the railroad equipment industries; E. P. Brooks, assistant to vice-president, formerly of the sales executive staff of Sears-Roebuck & Company; all with headquarters at New York. Mr. Foote was born on December 16, 1892, and became associated with the Greenville Steel



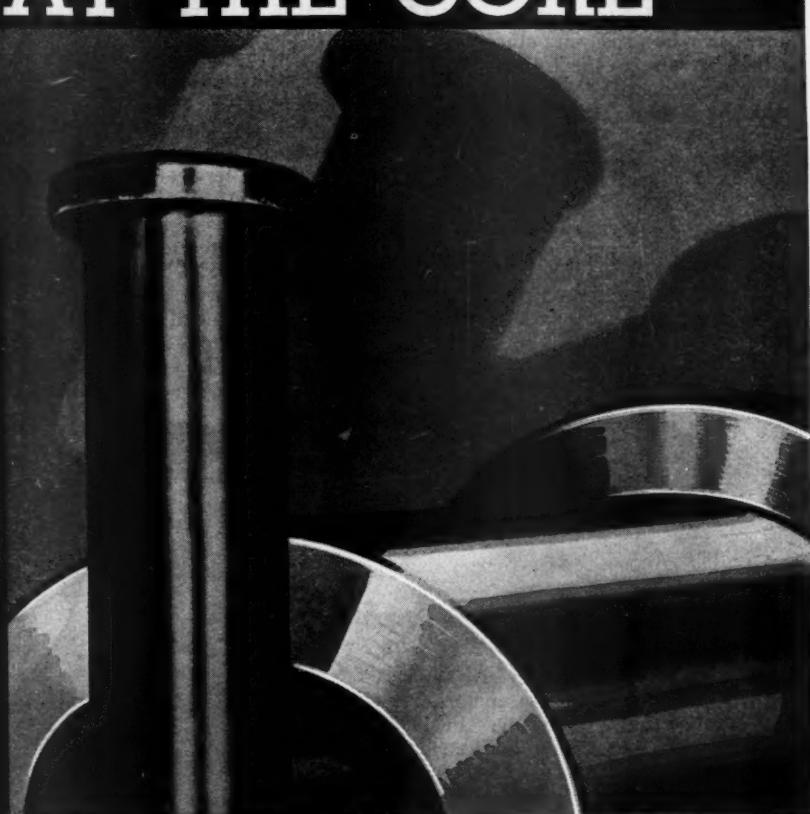
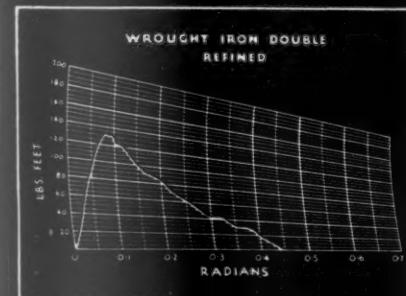
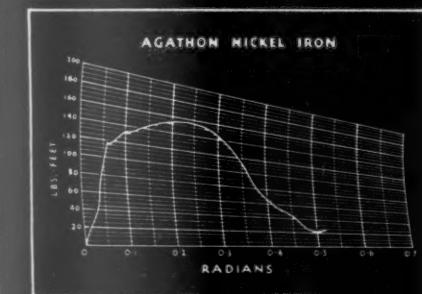
F. D. Foote

Car Company as purchasing agent in 1912. Four years later he became a director and secretary and treasurer of the company, and in 1924 was elected president. When the Greenville Steel Car Company became a subsidiary of the Pittsburgh Forgings Company in January, 1930, Mr. Foote became vice-president of the latter company retaining the presidency of the Greenville Steel Car Company. In March, 1932, he became president of the Pittsburgh Forgings Company, which position he held until he became associated recently with the United States Steel Corporation, as an assistant to C. L. Wood, commercial vice-president. Mr. Foote has served for several years as a director of the American Railway Car Institute.

R. E. HELLMUND, who has been appointed chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is the first Westinghouse executive to hold this office since the death of B. G. Lamme in 1924. Born in Gotha,

(Turn to next left-hand page)

HARD AT THE SURFACE TOUGH AT THE CORE



MATERIALS for wearing parts have heretofore been a

compromise. A hard surface meant a brittle core and if the core was tough enough the surface was too soft.

It remained for Republic to develop in Agathon Nickel Iron the ideal material that combines hardness of surface with toughness of core. How well Agathon Nickel Iron backs up a hard case with a tough core is shown by the above charts. The Humphrey Machine which produced these charts, bends the full section to the breaking point of the case and then on to final rupture. The first break in the line indicates the point at which the case was first cracked; the rest of the curve shows the resistance of the core to rupture. The core of the wrought iron shows rapidly diminishing resistance as the angle of bending increases. Agathon Nickel Iron, on the other hand, shows stubborn resistance even after the case is broken. The core is tougher and uniform in composition. Use Agathon Nickel Iron for all case-hardened parts.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

CENTRAL ALLOY DIVISION, MASSILLION, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES

R

YOUNGSTOWN, OHIO



LES

Germany, Mr. Hellmund was graduated from Ilmenau University, following which he worked three years, and then continued his studies in Charlottenburg University. He was graduated from that school in 1899 with the degree of electrical engineer. After graduation he began his career as a designer of electrical machinery in a large manufacturing concern in Germany, and later performed laboratory work and designed switchboards for other concerns. In 1904 he came to the United States and was associated with William Stanley at Great Barrington, Mass., on the develop-



R. E. Hellmund

ment of self-compounding alternators. Later he designed induction motors for the Western Electric Company. In 1907 he joined the Westinghouse Electric & Manufacturing Company, first engaging in work of the general engineering department and later being placed in charge of all design of direct current and alternating current railway motors. In 1917, Westinghouse officials gave him miscellaneous consulting duties in which he continued until 1921 when he was appointed engineer supervisor of development. In 1926 he became chief electrical engineer, which position he has held until his present appointment.

H. W. COPE, assistant director of engineering of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed assistant to the vice-president, in which position he will direct the co-ordination of certain headquarters engineering departments and district office engineers. Mr. Cope was born at North Vernon, Ind., and was graduated from Franklin College and Purdue University. Immediately after receiving his degree in electrical engineering, in 1898, he entered the Westinghouse organization. After serving in the testing department, he worked in the engineering division and later was appointed manager of the alternating current department. In 1909 he was appointed assistant to the manager of the industrial department and in 1914 became director of exhibits for the Westinghouse Company at the Panama-Pacific International Exposition, San Francisco, Cal. Mr. Cope returned to East Pittsburgh, in 1916 as assistant to the manager of engineering and since 1920 served as assistant director of engineering.

Obituary

LE GRAND PARISH, former president of the American Arch Company, Inc., and the Lima Locomotive Works, Inc., died at the Hackensack Hospital in Hackensack, N. J., May 10, 1933. Since his retirement from the American Arch Company in February, 1926, he had taken an active interest in welfare and civic affairs in Passaic County, N. J., and also traveled much in this country and abroad. Mr. Parish was born at Friendship, N. Y., April 13, 1866. In September, 1887, he entered the laboratories of Thomas A. Edison where he remained until early in 1889 when he left to enter the service of the Gilliland Electric Company, Adrian, Mich. In 1891 he became a storekeeper on the Lake Shore & Michigan Southern at Adrian, Mich. Three years later he became chief clerk in the car department at Englewood, Ill., and later was made general foreman at that point and then master car builder of the Western division, his jurisdiction in this capacity being extended in June, 1900, over



Le Grand Parish

the Michigan division, with his headquarters still at Englewood. In November, 1904, he was promoted to assistant superintendent of rolling stock, with headquarters at Cleveland, Ohio, and in July, 1906, became superintendent of motive power, remaining in that capacity until April, 1910, when he resigned to accept the presidency of the American Arch Company. In August, 1918, he was elected president of the Lima Locomotive Works, Inc., remaining in that capacity, and also as president of the American Arch Company, until January, 1924, when he relinquished the presidency of the locomotive company. In February, 1926, he retired as president of the American Arch Company, Inc. Mr. Parish, while he was in railway service, was unusually active in the Master Car Builders' Association and the American Railway Master Mechanics' Association. He also served as president of the Western Railway Club. He possessed real genius as an organizer and as a developer of men, this being demonstrated in a very marked degree in his administration of the mechanical department of the Lake Shore & Michigan Southern. At the time of his death he was the vice-president of the park commission of Passaic County, N. J., a member of which he had been since the organization of the commission in November, 1927.

Personal Mention

General

W. G. BLACK, assistant vice-president of the Chesapeake & Ohio, the New York, Chicago & St. Louis and the Pere Marquette, with supervision over purchases and stores, has been appointed vice-president of these companies with headquarters as before at Cleveland, Ohio. Mr. Black will have supervision over purchases and stores in addition to such other duties as he has heretofore performed. He was born on April 19, 1877, at Lima, Ohio, and after a public school and business college education, entered railway service in 1893 as a machinist apprentice at the Stony Island (Chicago) shops of the Nickel Plate. In 1897, he left railway service to continue his education at Armour Institute of Technology, Chicago, where he took a post graduate course in mechanical subjects. He then returned to railway service as a machinist at the Burnside (Chicago) shops of the Illinois Central and from 1900 to 1903 he was employed at the South Chicago plant of the Illinois Steel Company, then returning to the Nickel Plate as a machinist. Mr. Black was soon promoted to machine shop foreman and in 1904 he was promoted to enginehouse foreman at Ft.



W. G. Black

Wayne, Ind. On January 1, 1909, he was further promoted to master mechanic at Stony Island shops, where he remained until February, 1923, when he became superintendent of motive power of the Nickel Plate and Lake Erie & Western districts of the Nickel Plate, with headquarters at Cleveland. On January 1, 1927, Mr. Black's jurisdiction was extended to include the entire Nickel Plate system, and in the following month he went with the Erie as mechanical assistant to the president, with headquarters at Cleveland, leaving this company in 1929 to go with the C. & O. in the same capacity. Subsequently his jurisdiction was extended to include the Pere Marquette and in 1931 he was appointed assistant vice-president of the C. & O. and Pere Marquette with jurisdiction over purchases and stores matters. In March, 1933, he was appointed also to the same position on the Nickel Plate. His appointment as vice-president of the three roads became effective on April 17.

(Turn to next left-hand page)

A NEW RADIAL BUFFER TYPE "E-2"



**Deadens vibration
on big power**

**Permits maintenance
without uncoupling**

**Needs no additional
engine for uncoupling**

For years Franklin Radial Buffers have provided an ideal, non-binding connection between engine and tender that made both a single unit.

Now in a new design (Type E-2) the Franklin Radial Buffer affords even additional advantages.

Its smooth, powerful action deadens vibration and provides increased resistance to compression, resulting in improved riding qualities.

Without disturbing the connection between engine and tender all parts are easily inspected

and when necessary shims can be inserted to compensate for wear without dismantling or disconnecting.

This new design of buffer meets the demands of modern high-power, high speed operation and at the same time reduces maintenance cost.

Old existing buffers can often be converted to the new "Type E-2", accomplishing a substantial economy in maintenance. Ask Franklin about this.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK

CHICAGO

MONTREAL

L. RICHARDSON, formerly chief mechanical officer of the Boston & Maine, has been appointed mechanical assistant to the vice-president and general manager of that road and mechanical assistant to the general manager of the Maine Central. The position of chief mechanical officer has been abolished. Mr. Richardson was born at Shelbyville, Ky., on July 11, 1889, and was educated at Cornell University (M.E. degree in 1910) and University of Illinois. He entered railroad service in 1907, as a regular apprentice with the Pennsylvania, in which capacity he served until 1910. Subsequently he served as a special apprentice, motive power inspector, and foreman. Mr. Richardson joined the naval aviation



L. Richardson

corps during the war and during 1919-20 served as assistant supervisor of equipment with the United States Railroad Administration. From 1921 to 1923 he was sales engineer of the American Steel Foundries, working on the Virginian Railway, and during 1923-24 he was in charge of railroad sales of the Whiting Corporation. During 1925 and 1926 he served as contracting engineer of the Dwight P. Robinson Company. In 1926 Mr. Richardson entered the service of the B. & M., as assistant to chairman of the executive committee. He later served as assistant to president of that road and in April, 1927, was appointed mechanical superintendent. He became chief mechanical officer in 1929.

D. C. REID, formerly mechanical superintendent of the Boston & Maine, has been appointed general superintendent of motive power of the Boston & Maine and the Maine Central. The position of mechanical superintendent of the B. & M. has been abolished. Mr. Reid was born on April 7, 1890, at Chicago, Ill., and was educated in the public schools of East Chicago, Ind. He entered railroad service in June, 1906, with the Chicago Terminal and for four years was a machinist apprentice on this road. He then served with the Elgin, Joliet & Eastern during 1910 and 1911, after which he became associated with the Hubbard Steel Foundry. During 1912, he was in the employ of the Goldschmidt Detinning Company. He then went with the New York Central as a machinist. He became assistant enginehouse foreman in October, 1917; night enginehouse foreman in November, 1917; day enginehouse foreman in December, 1920; general enginehouse

foreman in October, 1922, and in July, 1926, master mechanic of the Indiana Harbor Belt, with headquarters at Chicago. In March, 1927, Mr. Reid entered the service of the Boston & Maine as superintendent



D. C. Reid

of locomotive maintenance, and in 1929, became assistant chief mechanical officer. In the latter part of 1932 he was appointed mechanical superintendent.

F. W. BUCKPITT, master mechanic of the Boston & Maine, at Boston, Mass., has been appointed superintendent of locomotive maintenance of the Boston & Maine and Maine Central, with jurisdiction over engine terminals and locomotive performance.

DOUGLAS M. BURCKETT, electrical engineer in the engineering department of the Boston & Maine, has been appointed also electrical engineer, mechanical department, which position was formerly held by the late Louis C. Winship. Mr. Burckett was born in Boston, Mass., December 18, 1895, and was educated at the Massachusetts Institute of Technology, graduating with the degree of S.B. and M.S. in 1922. Following two years service in the World War, Mr. Burckett entered railroad service in 1926, as assistant engineer, Great Northern, with headquarters at Seattle, Wash. He was later appointed assistant electrical engineer, and since October, 1929, has been connected with the Boston & Maine as electrical engineer in the engineering department.

Master Mechanics and Road Foreman

L. ALLEN, master mechanic of the DeQuincy division of the Gulf Coast Lines, with headquarters at DeQuincy, La., has been appointed assistant master mechanic.

H. C. GUGLER, master mechanic on the Chicago, Burlington & Quincy, has had his headquarters moved from Chicago to Clyde, Ill.

E. R. BATTLEY, superintendent of shop methods of the Canadian National, has been transferred to the central region as general superintendent of motive power and car equipment. Mr. Battley's former position has been abolished and his former duties taken over by Frank Williams, mechanical engineer in charge of shop methods.

D. J. AYERS has been appointed master mechanic of the Fitchburg division of the Boston & Maine, with headquarters at Greenfield, Mass.

F. R. HOSACK, master mechanic of the Kingsville division of the Gulf Coast Lines, with headquarters at Kingsville, Tex., has had his jurisdiction extended to include the DeQuincy division.

S. W. INKS, general foreman locomotive department of the Pittsburgh & Lake Erie, has been appointed master mechanic of the Monongahela with headquarters at South Brownsville, Pa.

H. F. NOYES, superintendent of motive power of the Maine Central, has been appointed master mechanic, with headquarters as before at Portland, Me. The position of superintendent of motive power has been abolished.

H. L. LEIGHTON, formerly master mechanic of the Fitchburg division of the Boston & Maine, with headquarters at Greenfield, Mass., has been transferred to Boston, Mass., as master mechanic of the Terminal and Portland divisions.

W. S. TASKER, master mechanic of the Panhandle division of the Atchison, Topeka & Santa Fe, with headquarters at Wellington, Kan., has had his jurisdiction extended to include the First and Buffalo districts of the Plains division.

G. R. MILLER, master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., has had his jurisdiction extended to include the Second, Third, Shattuck, Dumas, Clinton, Borger and Skellytown districts of the Plains division. Mr. Miller's headquarters are now at Amarillo, Tex.

Car Department

A. J. KRUEGER, master car builder of the New York, Chicago & St. Louis, has had his headquarters moved from Cleveland, Ohio, to Conneaut, Ohio.

J. P. JANGRO, superintendent of car maintenance of the Boston & Maine, has been appointed also superintendent of car maintenance of the Maine Central.

Purchasing and Stores

M. S. SMITH has been appointed store-keeper of the Monongahela with headquarters at South Brownsville, Pa.

ALBERT NORDBERG, master mechanic of the Pittsburgh & Susquehanna at Philipsburg, Pa., died on May 2 after an illness of 14 months. Mr. Nordberg entered the service of the Altoona & Philipsburg, later known as the Pittsburgh & Susquehanna, in 1893 as a bridge builder. He was the first foreman of the car repair shops at Rainey, Pa., and in 1915 became master mechanic, in which position he continued until the road suspended operations in August, 1931.